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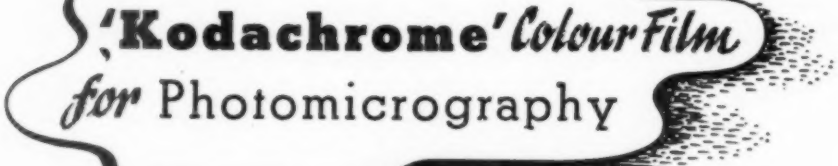

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Scientific Research and the National Register

OF the importance of the part that will be played by men of science in the activities of any country that is, unhappily, engaged in modern warfare, there is no question. All are agreed on that point, and it is deeply to be deplored that the same agreement is not to be found concerning the contribution which they can make, and are ready to make, towards the solution of many of our peace-time problems, nor is the same desire shown to develop organizations which may serve to harness their abilities to that end. It is the tragedy of the times in which we live, that the forces of peace are unorganized, though collectively they are impressive enough in magnitude, and that the threat of war should be needed to orient and to organize man's activities to serve a common national need.

The best for which we can hope, in the present state of muddled thinking on the part of those to whom the nations of the world have confided their destinies, is that, should the shadow of war be lifted from the world, the organizations which the threat of war has called into being may be redirected and extended to serve more worthy ends. This has been done successfully in the past. The Ordnance Survey of Great Britain, which has developed almost beyond recognition since its inception at the end of the eighteenth century, and the pacific activities of which far transcend its wartime usefulness, took its origin from a war-measure ; and it needed the stress of the war of 1914–18 to call into being the Department of Scientific and Industrial Research. The plain truth is that man is an unimaginative creature, and Bastiat's argument concerning what is seen and what is not seen is pertinent to many more realms of thought than the economic one. Everyone's imagination is shocked by the thought of a great modern city pounded to a heap of smoking ashes ; it is not so easy, in a bustling cheerful town, with cinemas filled to overflowing, and shops exhibiting merchandise gathered from the four corners of the earth, to realize that the country is faced with grave problems of malnutrition, problems the solution of which demands as close co-operation, as much teamwork, and as high and devoted enthusiasm as ever were brought to bear on a war-time problem. To-morrow is time enough for the problems which are not seen ; the threat of war brings with it problems to be attacked to-day.

Among the needs of Great Britain at the present time is a register of names of those possessing professional, scientific, technical and higher administrative qualifications. Concerning the war-time value of such a register, there is no question ; and it should be equally evident that it will have a high value for a nation which is awakening to the need for a successful attack on the problems of peace. It is the first step towards that co-ordination of our expert services which is so urgently needed ; on the scientific side, it is the first instalment of that catalogue which will help us make a mental picture of the research activities of the country—to show us, in fact, what lack of co-ordination exists, what avoidable overlappings are evident, what gaps in our research problems need filling, and where border-line problems may most profitably be attacked.

The National Service Department of the Ministry of Labour is compiling such a register, and the register, in the event of war, will provide for the Government a list of persons willing to serve in their professional capacities in some appropriate way. The emphasis here is on the word 'appropriate'. The National Service Department is fully

alive to the consequences of the errors of assignment made in the war of 1914–18, and is anxious to avoid a repetition of those errors, and to ensure that each man who offers his services is assigned to that task for which his knowledge, training and capacities best fit him. To that end the Royal Society has been asked to co-operate by compiling the section of the register dealing with persons "*normally engaged in, or qualified to undertake, scientific research*". These terms of reference should be carefully noted, for the register will defeat its own ends if it consists of an *omnium gatherum* of all persons who may be said to have had a scientific training, or who, without any special qualifications for research, are normally engaged in more or less routine work of a scientific character.

The officers of learned societies, and the heads of scientific departments in university and similar research institutions, have been asked by the Royal Society to furnish a list of those persons to whom an inquiry should be sent, and it is important here to note the relation between the Scientific Research Register and the Universities Register which was undertaken some months ago. Possibilities of overlap, confusion and of endless filling-in of forms are present in the minds of many inquirers, and it should be borne in mind that the Scientific Research Register undertaken for the Ministry of Labour by the Royal Society, as it is the latest, will probably be the last of its kind, and that it differs in three important respects from the Universities Register. In the first place, inclusion in the Scientific Register implies an *obligation*, "to serve [in wartime] in an appropriate way in their professional capacity and to accept such suitable work as is offered to them". It is perhaps desirable to emphasize this obligation, and to point out that the sub-committees set up to advise in the several subjects and to consider in advance the most suitable employment of individuals, consist of scientific men, who will approach their task with full knowledge. No obligation was, of course, implied in the Universities Register.

Again, the names of individuals included in the Scientific Research Register will not be included in the Universities Register. It is necessary to have a single register for all persons normally engaged in, or qualified to undertake, scientific research. It is obvious that a large proportion of such persons will not be in the universities, and it is therefore desirable to separate the two registers.

In the third place, the cards for the Universities Register do not supply certain items of information which are regarded as important for the Scientific Research Register. In particular, no provision was made for that detailed classification of the individual's special qualifications, which is particularly important for the rapid and efficient use of the register.

The Ministry of Labour has set up a special Committee for Scientific Research of the Central Register Advisory Council, which will have the duty of dealing with the information given on the cards of this latest register. The names of the members of this Committee, which are given on another page (p. 592), and of the co opted members of the various sub-committees, afford sufficient guarantee that the problems of assignment will be handled efficiently and sympathetically, and that there is little danger, say, of the expert chemist's finding himself allotted to the elucidation of a problem in hydrodynamics, or being haled off to busy himself with minor work of an administrative kind.

The Scientific Research Register, it must be remembered, is part of a larger scheme, for the Ministry of Labour is engaged in compiling a Central Register of nine sections of which the Scientific Research Register is one, the remaining registers being devoted to General Engineering, Mining and Metallurgy, Industrial Chemistry, Architecture and Public Utilities, Universities and Teaching, Administration and Management, Accountancy, and Journalism, Languages, etc. It is inevitable that overlap will occur, and in such cases cross-references will be made.

The institution of such a register marks a great advance in the co-ordination of the national services of Great Britain and in the availability of the nation's experts. It is a signal advantage to have the information contained therein collected by one Department, and set out in a consistent fashion, so as to be readily available. The immediate stimulus for the production of this register is the spectre of war, on a scale and of an efficiency which are terrifying to contemplate. This, however, should not deter scientific workers from doing their part in making the register as comprehensive as possible; for, with due provision for keeping it up to date, it should be a lasting foundation on which to build up a scientific service covering all the activities of the nation in peace as well as in war, in preparation for the time when the gifts of science to mankind shall become the keystone of progressive civilization.

Scientific Biography and Correspondence

(1) **Copernicus:** the Founder of Modern Astronomy. By Angus Armitage. (History of Science Library.) Pp. 183. (London: George Allen and Unwin, Ltd., 1938.) 10*s.* net.

(2) **Galileo and the Freedom of Thought** By Dr. F. Sherwood Taylor. (Library of Science and Culture.) Pp. xv + 212 + 5 plates. (London: Watts and Co., 1938.) 7*s.* 6*d.* net.

(3) **The Mathematical Work of John Wallis, D.D., F.R.S. (1616–1703)** By Dr. J. F. Scott. Pp. xi + 240. (London: Taylor and Francis, Ltd., 1938.) 12*s.* 6*d.*

(4) **Briefe Franz Xaver Freiherrn von Zach und seines Nachfolgers Bernhards von Lindenau von 1791–1816 an P. Martin Alois David** Herausgegeben von Otto Seydl. (Publikace Pražské Státní Hvězdárny, C. 11.) Pp. 206. (Praha: Státní Hvězdárny Republiky Československé, 1938.) n.p.

THERE may appear to be little to connect these four works beyond the evidence they bear in common to a wider interest in the history of science. This is very welcome. Two of them bear witness further to the active encouragement now given by the University of London to the cultivation of the historical aspect of science. The object is admirable. But it cannot fail to be noticed that success in this line of research is exceedingly difficult of attainment. To the ordinary qualifications of a historian must be added a mature judgment of scientific values. Separately, these are not common qualities; in conjunction they must be rare indeed.

(1) This book on Copernicus is rather a curious one. It is clearly intended for a wide circle of readers. Perhaps on that account it conveys the estimate of Copernicus which has come to be traditional, as its question-begging sub-title implies. But the true nature of his great work is very fairly explained. It is shown that the mind of Copernicus was Aristotelian to the core and that he followed Ptolemy in the main with great fidelity. So far from being the founder of modern astronomy, it would be far truer to regard his work as the final chapter of the ancient science. It might have been written at any time in the preceding twelve centuries. Indeed, Dreyer has raised the question why the critical step was not taken by Ptolemy himself, and has suggested his own answer. Perhaps the clue is sufficiently revealed in the present book (p. 155), where the Copernican is claimed as a heliocentric theory, whereas it is stated a few lines before that the longitude of Mars might be 3° in error precisely because the computation is based on a theory which is not heliocentric.

The sketch of the life of Copernicus is drawn from German authorities. It is interesting for the striking justification in a case of episcopal nepotism by which Copernicus profited. His opportunities for education were extended far beyond the ordinary limit, and when he returned to his canonry, ecclesiastical duties seem to have formed the least part of his life. His freedom from theological bias ceases to be surprising.

The account of all earlier planetary theories given in an introductory chapter is necessarily brief. But this was not really needed. What is essential for an understanding of Copernicus and of Kepler is a full explanation of the work of Hipparchus and Ptolemy and, above all, of the terminology associated with the Ptolemaic system. The reader would have gained greatly if his attention had been concentrated on this one vital theory to the exclusion of all competing detail.

The true founders of modern astronomy were Tycho Brahe, Kepler and Galileo. Tycho rejected the Copernican theory, and Kepler superseded it within little more than half a century. Therefore the problem confronting those who wish to maintain that the theory has any great historical importance is to show that, nevertheless, Tycho in his observations and Kepler in his analysis were seriously influenced by it. That is a question which is not approached in this little book.

Though Copernicus had undoubtedly a distinct individuality, his impact on the succeeding age may be quite conveniently attributed to two personalities. There is the Ptolemy-Copernicus concerned with the production of ephemerides, of real though limited interest to the technical astronomer; there is also the Aristarchus-Copernicus, who is identified in the popular mind with the heliocentric theory. Mr. Armitage has the merit of recognizing the first, but his valuations are based on the second.

(2) The book on Galileo is very readable, but it is disappointing in some respects. The historical background, which includes the counter-reformation, is clearly drawn, and this is a great merit. Details of personal appearance and character and an account of the family relationships add life to the portrait. Of the astronomical observations an adequate description is given. This was the work

of a pioneer in the field, and it is entitled to all the honour which it has received. But, as recriminations over priority show, others were ready to take up and carry on this work, and further advance depended mainly on the improvement of optical resources. The future of telescopic observation was assured, and even in the first step Galileo may have been anticipated by Harriot.

The real importance of Galileo rests on his position as the founder of dynamics. Therefore it might naturally have been expected that the most careful attention would be directed to this part of his work, to his experiments and to his deductions. In this respect the present book is very disappointing. The only reference to the parabolic motion of projectiles is contained in a few lines at the end of the book. The material and Galileo's mode of presentation have not made the task of the biographer easy; but his success must be judged mainly by his treatment of Galileo's achievement in the field of dynamics. Here the account is inadequate.

Two chapters, occupying a quarter of the book, are devoted to the conflict with the Church and the final trial and condemnation of Galileo in 1633. Translations of the principal documents are reproduced at length. The issue may have its importance in ecclesiastical history, but its significance in the history of science is slight. For Galileo, in his declining years, the penalties were heavy, but to these events he owed no small part of his enduring fame. Moreover, as Galileo stood as a champion of Copernicus, the latter owes no little in popular estimation to the same circumstances. All this is very strange because, as can be seen clearly enough now, Galileo, so far from being the bold innovator and leader of the advancing tide, was in sober fact a quarter of a century behind the times.

As early as 1597 Galileo had been in correspondence with Kepler. But when the *Astronomia Nova* appeared in 1609, he must have missed its importance completely. He was not an astronomer in the sense of Tycho; he was rather the first astrophysicist. He was not interested in the theories of Ptolemy-Copernicus, and he never progressed beyond the ideas of Aristarchus-Copernicus, in which he was confirmed by the weak argument from analogy afforded by the satellite system of Jupiter. Otherwise he would not have wasted his time on futile arguments, many of which were thoroughly unsound. But until a more precise meaning was given to the heliocentric theory, no decision could be reached by mere argument. This meaning was given by Kepler when he found that, relative to the sun, both the earth and Mars moved in elliptic orbits with the sun at one focus. After this first approximation, it was not necessary to wait for the measurement of stellar parallaxes, or even the discovery of aberration, for independent confirmation. The line of further progress was definitely set.

Galileo can scarcely be blamed for failing to appreciate the fundamental importance of Kepler's work. Huygens was equally blind and, making all allowance for half a century's progress, Huygens was a greater man than Galileo. But one contemporary mind did realize immediately the significance of Kepler's work. That was Thomas Harriot.

Galileo, as we are reminded here, was born in the same year as Shakespeare. He died, exactly one year after the death of Horrocks, in that same year which saw the birth of Newton.

(3) A life of John Wallis could scarcely fail to be interesting. Not that he required to be rescued from obscurity, as is here supposed. He has probably not fared worse than most eminent mathematicians, who are always prophets without honour, especially in England. Among mathematicians Wallis holds a high place, and if knowledge of his work has been fragmentary, he has been largely judged perhaps on the *ex pede Herculem* principle, which is not ungenerous. It may be doubted whether the present book adds to his stature or does him full justice.

The most valuable chapter of the book is the fourth, where a full account is given of the representation of π as the limit of a product sequence. The magnitude of the effort needed to reach a point a little in advance of the flowing tide of mathematical progress will be a revelation to all those who have had no occasion to refer to the original work. This was well worth reproducing, for it is a magnificent example of the use of induction and interpolation as a method of research, a method of which Newton also proved himself to be a complete master. As a *tour de force* in this kind, this feat of Wallis is surely unsurpassed, and Newton may well have profited by the example.

Interesting details of the early history of the Royal Society and of the events which led up to its foundation are duly related. But Dr. Scott has two fatal disqualifications as a biographer of Wallis. He is prudishly shocked by the atmosphere of controversy, and he is not technically qualified to form first-hand critical judgments. By accepting everything which has been said to the detriment of Wallis, he has drawn a picture which must be grotesque. For it is utterly incompatible with the position held by Wallis in the Royal Society, which was composed in the main of kindly and gifted men like Wren.

Wallis criticized the Greek mathematicians on the ground that they wished to be admired rather than understood. This fully explains his attitude to Fermat. The resulting controversy was

anything but sterile, and both men may now be regarded as the founders of the theory of numbers. Continued fractions are mentioned only in connexion with Lord Brouncker; but Wallis was the chief founder of that theory also. In the chapter on the "Algebra" the references to Harriot and Descartes are dealt with at disproportionate length without altogether removing an element of mystery. In alluding to Harriot as "a very great man in his time" Wallis was guilty of no exaggeration, and he certainly left papers behind, whether Wallis had seen them or not; the "Praxis" was only published ten years after his death. Down to the time of Harriot, an equation was simply a means to an end, the answer to some problem which required in general a positive and often an integral solution. It was the Cartesian geometry which altered that situation. Wallis, with his sense of generality and of algebraic form, was among the first to see the equation from a mathematical point of view apart from any particular application. In doing so he seems to have confused his own development with the work of Harriot, to which he may well have owed some part of his inspiration. Why, in over-estimating that debt, he should have become increasingly hostile to Descartes is not clear. The only hint is that to Wallis a suspicion of deliberate obscurity was a veritable red rag.

As the work of Wallis on mechanics is probably less well known than that in the field of pure mathematics, a competent analysis of the "Mechanica" would have been valuable. Unfortunately, Dr. Scott is not equipped for the task, as is shown clearly (p. 121) in the matter of the centre of percussion and centre of oscillation, where any point at issue with Huygens is completely obscured. It is useless to pursue the subject of the development of dynamics from Galileo to Newton and the part of Wallis therein. With misguided and irritating pedantry the author always uses the name Galilei; has it become wrong to speak of Dante?

An instance of the injustice done to Wallis by lack of knowledge may be found in the disparagement of his astronomical knowledge because he accepted Flamsteed's parallax of Polaris. Naturally he was no expert, and it was not for the Savilian professor of geometry to suspect an error on the part of the Astronomer Royal. The gibe also appears in Miss Clerke's article in the "Dictionary of National Biography". The incident shows how in similar circumstances a great man, Bradley, made the discovery of aberration, while a lesser man, Flamsteed, merely made a mistake. But it belongs to the life of Flamsteed; so far as Wallis is concerned, it is practically irrelevant.

Another incident is mentioned by Miss Clerke, and it is to be regretted that the details are not recorded in this book, for it is perhaps the finest scientific hoax ever perpetrated. Huygens announced the discovery of Titan by a cryptogram in 1655. But Wallis had anticipated this by a similar announcement so ingeniously constructed that after the event Huygens was led to believe that the satellite of Saturn had been observed in England at an earlier date. The true facts were disclosed in 1659. The deception may have been cruel, but it seems to have been effective in putting an end to a silly practice. It is a pity that Wallis was not equally successful in bringing to a close that other unmitigated nuisance, the challenge problem.

In an appendix a sort of "Who's Who" is given of the scientific men of the period. The value of a compilation of this kind depends entirely on its accuracy. Now Harriot, though a remarkable man certainly, did not live to the age of 120 years. He died in 1621, not 1681. This is a mere misprint. But the confusion between the works of Kepler can scarcely be explained in the same way. Nor is the list of contemporaries complete. Since the theory of equations plays so great a part in the text, the absence of Tschirnhausen can scarcely escape notice.

The specimen pages reproduced from Wallis and various authors of the period are of great interest. But in a work of this kind a complete bibliography is to be expected as a matter of course. It is emphatically not enough to copy out the contents of the Oxford collected edition (1693–99).

The author's industry is attested by the references given at the foot of nearly every page. The life of John Wallis is a fine subject but a very difficult one. It is not suited to the pen of one whose whole horizon is evidently bounded by the work of Newton.

(4) The name of F. X. Freiherr von Zach is chiefly known to astronomers as that of the founder and first editor (1800–7) of the *Monatliche Correspondenz*, a useful medium for the communication of astronomical intelligence. Strangely enough, there is an important link between him and one whose name has already obtruded itself in the preceding notices. For it was on a visit to Lord Egremont at Petworth House in 1784 that he discovered the scientific papers left by Thomas Harriot, and it is from his account in the Berliner Jahrbuch (1785, 1793) that the nature of Harriot's astronomical activity became known. This ranks Harriot as an astronomer in the same class with Galileo; and, be it remembered, this was one who had been to America and returned and written a remarkable book about it before the Armada. All things considered, the reputation of Harriot need depend little on a precise valuation of the merits of his "Praxis".

Father M. A. David was director of the Prague Observatory from 1800 until 1836, having been

connected with the institution for fifteen years previously. His first meeting with Zach took place at Karlsbad in 1789, the second and last at Gotha in 1801. From the correspondence which was carried on until 1805, when friendly relations were clearly broken off, sixty-two letters from Zach have been preserved at Prague and are now published. The nine additional letters of his successor Lindenau are of less interest. As David's replies have been lost, the value of the material lies chiefly in the light thrown on the character of Zach, who in that period of fourteen years shows himself as an admirable correspondent, keenly interested in all that was going on in the astronomical world, but chiefly in geodetic operations.

Born in 1754, Zach was educated at Paris, where he met Laplace and Lalande. In 1783 he was living in London, where he made contact with Maskelyne and Herschel and also the English instrument makers of the day. With the latter he had extensive dealings afterwards, both on his own account and for others. In 1786, under the Duke of Saxe-Gotha, he equipped a new observatory and directed it until the death of the Duke in 1804.

Of Zach's activity at that period there can be no doubt. But his voluminous correspondence with astronomers, his duties as editor and his active interest in geodetic operations must have interfered seriously with any astronomical work. It is therefore not altogether surprising to learn that after his resignation the observatory was found to be in a deplorable state. Indeed, after the Duke's death, Zach disappears to all intents and purposes from the world of astronomy, though he still found occupation in editing a journal.

Had the Freiherr v. Zach been an indifferent musician or poet, instead of an indifferent astronomer, his later career would have provided material for a romantic biography. He attached himself as Hofmeister to the Dowager Duchess, the widow of his patron, and accompanied her in her travels in France and Italy until her death in 1827. According to one account he married the lady. Five years after the death of the Duchess, Zach fell a victim to cholera in Paris.

Zach's friend and successor, B. A. von Lindenau, did not remain permanently attached to astronomy, but embarked on a political career which earned for him a reputation in Saxony as a statesman and philanthropist. He died in 1854.

The present collection of Zach's letters show him to have been not only an admirable scientific correspondent but also a most efficient medium for the forwarding of astronomical literature and arranging for the supply of instruments. They abound in allusions to the astronomers living at the end of the eighteenth century and they convey much information about the equipment of observatories at that time and, more particularly, about portable instruments for use in the field. H. C. PLUMMER.

Petroleum Literature

(1) The Principles and Practice of Lubrication: a Manual for Petroleum Technologists, Students, Engineers, Oil Salesmen, etc. By Prof. Alfred W. Nash and Dr. A. R. Bowen. Second edition, revised. Pp. xi + 345 + 28 plates. (London: Chapman and Hall, Ltd., 1937.) 18s. net.

(2) The Principles of Motor Fuel Preparation and Application
By Prof. Alfred W. Nash and Dr. Donald A. Howes. Vol. 1. Second edition, revised and enlarged. Pp. xiv + 628 + 15 plates. (London: Chapman and Hall, Ltd., 1938.) 36s. net.

(3) The Chemistry of Petroleum Derivatives
By Carleton Ellis. Vol. 2. Pp. 1464. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) £5 net.

THE oil industry is one of the most important of any, and it is in keeping with its rapid expansion that it has an ever-extending literature of the first rank which, perhaps more than any other, is continually being revised and kept up to date. In Great Britain we are fortunate in that Prof. A. W. Nash of Birmingham is willing to devote a large portion of his time to making his knowledge available to his students and contemporaries.

(1 and 2) Prof. Nash's book on lubrication, which has now become an exact science, has been brought up to date in a second edition eight years after its first appearance. More recently the second edition of his "Motor Fuel" has appeared, in this instance after only four years. Even in this short space of time much has had to be added, in particular a section dealing with polymerization and pyrolysis. These processes have enabled superior grade petrols or gasolines, as they are termed in America, to be produced synthetically from both natural and cracked hydrocarbon gases, thereby adding to the total yield of motor-car fuel which can be obtained from a ton of crude oil and so contributing to the conservation of this material. Such high-grade fuels have a direct

connexion with the performance of the modern engine, particularly in aeroplanes at high speeds. Indeed, some of the more daring experts predict the advent of a day when crude oil is first cracked to gas and the fragments reunited in a controlled manner to form high-grade products.

(3) In the United States, Carleton Ellis is an equally prolific writer, and vol. 2 of his "Chemistry of Petroleum Derivatives" appears four years after vol. 1. It is very long and contains a wealth of information in fifty-four chapters. With the industry greedy to make use of his discoveries, the chemist has achieved much in this field and it would make an interesting task, far too lengthy to undertake here, to contrast the state of knowledge relating to the hydrocarbons forty years ago and to-day. It is possible even to suggest that Mr. Henry Ford, when he made the automobile available to everyone, unknowingly inspired even more chemical research than engineering development. To-day this is going on faster than ever, partly because there is no knowing which particular line of work may become a major technical development in the near future.

Such a book as this saves hundreds of hours of valuable time to the worker, and in this way accelerates the tempo of new work.

Microchemistry

(1) Qualitative Analyse mit Hilfe von Tüpfelreaktionen:
Theoretische Grundlagen, Praktische Ausführung und Anwendung. Von Dr. Fritz Feigl. Dritte neu bearbeitete Auflage. Pp. xii + 554. (Leipzig: Akademische Verlagsgesellschaft, m.b.H., 1938.) 30 gold marks.

(2) An Introduction to Microchemical Methods: for Senior Students of Chemistry. By Dr. Cecil L. Wilson. Pp. xi + 196. (London: Methuen and Co., Ltd., 1938.) 7*s*. 6*d*. net.

(1) THE popularity of spot methods of analysis is evident not only from the increasing number of text-books dealing with this section of microchemistry but, more particularly, from the fact that in the course of seven years three editions of Prof. Feigl's authoritative treatise have been called for, while, in addition, there have been English and Russian translations. To each edition subsequent to the first there have been made numerous additions, and this third German edition contains many new tests, some of which have not hitherto been published. The theoretical part of the book has also been enlarged, not only by the amplification of many of the original chapters, but also by the inclusion of chapters dealing with fluorescent analysis and spot tests, and the influence of substitution on solubility.

In the practical section, drop reactions are given for the first time for germanium, platinum, indium, gallium, lithium and cæsium, and for hydrazoic acid, while the chapter on the systematic investigation of inorganic mixtures has been expanded by the inclusion of preliminary tests for the detection of anions. To the organic compounds and radicals dealt with in the second edition (reviewed in NATURE, **136**, 89; 1935), there have now been added schemes for the detection of formaldehyde, methyl alcohol, *p*-phenylenediamine, phosgene, aromatic *m*-nitro compounds, oximes and hydroxamic acids, acid amides and nitriles, pyrrole derivatives, and α-amino acids. A number of new applications of spot tests is also given.

In order that the size of the book should not be unduly increased, space has been saved by omitting the preparation of reagents and by mentioning only briefly those tests which are less sensitive or well known.

(2) This interesting, although somewhat ambitious text-book, is meant to serve as an introduction to microchemistry, and is intended primarily for senior students in chemistry. With the exception of quantitative organic analysis, it treats of all the usual sections of the new science, such as chemical microscopy, the use of the polarizing microscope, spot tests, inorganic qualitative and quantitative analysis, organic qualitative analysis, colorimetry, photomicrography, and spectroscopy. It is obvious that in such a small compass the author can be but briefly descriptive, that practically all theoretical treatment must be omitted, and that the number of examples provided must be limited. Nevertheless, enough is given to illustrate the various methods, and to enable the student to acquire sufficient confidence and skill to permit him to make effective use of more advanced text-books.

Although much is compressed into a little space, the monograph is clearly written, and is easy to read, while the text is effectively illustrated by numerous figures and photomicrographs.

G. R. DAVIES.

Vergleichende Morphologie der höheren Pflanzen
Von Prof. Dr. Wilhelm Troll. Band 1: Vegetationsorgane. Teil 1, Lieferung 3. Pp. xii+509–955. (Berlin: Gebrüder Borntraeger, 1937.) 39.50 gold marks.

THE third "Lieferung" of the first part continues the large subject of branching in ferns and seed-plants. Axillary branching is discussed, as also the exceptions thereto, such as epiphyllous displacement of the lateral branch, and dichotomy in palms. Accessory or supernumerary axillary shoots and their independent origin from the meristem of the axil-tissue are described. The section on the structure of lateral shoots is replete with interesting and varied examples.

Following this is an engaging account of sub-cotyledonary shoot-formation, instances of which are given in *Linum*, *Linaria*, *Cyclamen*, *Orobanche*, *Euphorbia*, etc. In the parasitic families of Orobanchaceæ, Balanophoraceæ and Rafflesiaceæ hypocotyledonary and root-shoots entirely replace from the beginning the main shoot, which never exists at all in their life-history. There is a lengthy and well-illustrated chapter on the influence of symmetry conditions on branching—a very wide subject, and of far-reaching importance.

The next section deals with the orthotropous and plagiotropous growth of shoots.

A valuable and interesting section is that headed "Storage Shoots". It treats of (1) the origin and structure of rhizomes; (2) bulbs; (3) hypocotyledonary tubers and allied structures: amongst these are described the remarkable forms occurring in the Dioscoreaceæ, some of which are rhizomes, others root tubers, and still others shoot tubers; and finally (4) rhizome and stolon tubers exemplified, for example, in *Stachys tuberifera*, *Trientalis europaea*, *Crepis bulbosa*, *Arum maculatum*, *Crocus*, etc.

Section 7 deals with twining and tendril-forming shoots; and no one could wish for a more thorough treatment of this subject.

The final section provides a most interesting and instructive account of the form-relationships of *stem-succulent* plants.

The whole "Lieferung" is splendidly illustrated with photographs and drawings. W. C. WORSDELL.

Handbuch der Anorganischen Chemie
In vier Bänden. Herausgegeben von Prof. Dr. R. Abegg, Dr. Fr. Auerbach und Dr. I. Koppel. Band 4, Abteilung 3: Die Elemente der achten Gruppe des periodischen Systems. Teil 2: Eisen und seine Verbindungen. A. Leiferung 3: Legierungen und Verbindungen des Eisens mit H, B, Si, P, As, Sb, Bi, S, Se, Te. Von Dr. I. Koppel. Pp. viii+559–723. (Leipzig: S. Hirzel, 1938.) 20 gold marks.

THE chemistry of such a widely used and technically important element as iron is so extensive that it is not surprising that the editors of this well-known "Handbuch" have found it necessary to divide the comprehensive study of iron and its compounds into more than one book.

It can be seen from the title that the volume under review constitutes the second part of this monograph on iron and includes the combinations of this element with some ten non-metals and metalloids. It possesses all the desirable features of comprehensiveness and simplicity in the arrangement of the subject matter, which have made Abegg justly popular among chemists. The thoroughness with which the literature has been covered may be gauged from the fact that there are references from 1718 up to the middle of 1937, and, what is more, they can be found without difficulty.

Workers on iron will find this book invaluable within the scope of the title, and it should be on the shelves of every reference library dealing with chemical or metallurgical topics. It is printed in clear type on good paper.

Beiträge zur Mineralogie von Japan
Begründet von T. Wada. Neue Folge, II. Herausgegeben von T. Ito. Pp. xii+168+9 plates. (Tokio, 1937.) n.p.

PROF. T. ITO, of the Mineralogical Institute of Tokyo, is continuing the excellent work begun by the late Prof. T. Wada by publishing the results of the investigation of the minerals and rocks of Japan and its dependencies. The present part is devoted to the composite sill which intrudes into the Tertiary formations near Kergan in north-eastern Korea. It is styled a sill, although the shape owing to the effect of the interposing rocks is more varied than is ordinarily understood by the term. The core consists of a syenitic rock, above and below which is a compact syenite-dolerite.

A full and careful description is given of the rocks and the various minerals composing or associated with them. The investigation includes the study of X-ray powder diagrams of goethite and of certain pyroxenes, the diagrams being reproduced on three of the plates. The frontispiece takes the form of a plate, on which are reproduced in colour a specimen of goethite in natural size and of specimens of goethite and aegirine as seen under the microscope.

The text is in Japanese, but the book can be understood without a knowledge of this language, since the crystal forms and angular measurements are expressed in the customary manner and a good abstract in English is incorporated at the end. The alternative title-page is still retained in German.

Die Chromatographische Adsorptions-methode: Grundlagen, Methodik, Anwendungen. Von Prof. Dr. L. Zechmeister und Dr. L. v. Cholnoky. Zweite wesentlich erweiterte Auflage. Pp. xiii+354. (Wien und Berlin: Julius Springer, 1938.) 19.80 gold marks.

IN twenty months this book, of which the first edition was reviewed in NATURE at some length (140, 48; 1937), has gained 125 pages—an increase of fifty per cent. This remarkable growth-rate is testimony not only to the importance of the subject, but also to the author's admirable exposition thereof. It should augur well for the success of the English edition now in preparation. A. L. B.

Recent Developments in Cyclotron Technique

By Dr. W. B. Mann, Imperial College, London

AT Berkeley, California, the first cyclotron to be built for the purpose of medical and biological research is nearing completion. In Great Britain it still remains a matter for debate as to whether the immediate expenditure on the construction of a medical cyclotron would be justified or whether it would, perhaps, be better policy to await the outcome of the research which has already been started in Berkeley.

The underlying principles of the cyclotron have already been adequately described in these columns by Prof. J. Chadwick (NATURE, **142**, 630; 1938). It will therefore be the purpose of this article to try to enumerate some of the developments that have been made during the last few months.

Perhaps the most important of these developments has been the completion in Berkeley of an investigation into the possibility of using the very large currents circulating within the 'dees' of the cyclotron for the purpose of preparing artificially radioactive material. In the preparation of radioactive substances, either for therapeutic or for indicator purposes, it is important to obtain large yields. An increase in yield may be achieved in two ways: by using higher intensities, or, in the case of proton or deuteron bombardment, by the use of particles of higher energy.

In the latter case we are tacitly accepting the fact that the energies available are still considerably less than the energy corresponding to the top of the potential barrier of the bombarded nucleus, and that the yield is still rapidly increasing with increasing energy of the bombarding particle.

The purpose of the new cyclotron at Berkeley is to increase both the current and the energy of the emerging beam. With this cyclotron it is hoped to obtain deuterons with energies corresponding to accelerations in the neighbourhood of fifteen million electron volts. In the meantime, however, every effort is being made to increase the yields of radioactive products by using the large currents available within the 'dees' of the present cyclotron at Berkeley.

Prof. E. O. Lawrence had suspected the existence of large currents of circulating ions within the 'dees' and these suspicions were confirmed by the observations of R. R. Wilson, of the Radiation Laboratory, which were reported last August at the meeting at San Diego of the American Physical Society. It was found that in the case of deuterons, the ion current circulating within the 'dees' was of the order of one milliampere, the energies of the deuterons ranging from 6 to 9 million electron volts. Only some 10 per cent of the available current was, however, being withdrawn by the deflector and used in the target chamber.

A paper published by R. R. Wilson and M. D. Kamen last December describes the technique whereby these large currents of high-energy ions may be utilized in the preparation of radioactive phosphorus and iron. Previously, as has been described by F. N. D. Kurie, radioactive phosphorus had been prepared by bombardment of red phosphorus in an atmosphere of helium, the bombardment chamber being separated from the vacuum chamber of the cyclotron by means of a thin iron window, which was itself rendered radioactive by the deuterons passing through it. Thus both radioactive phosphorus for therapeutic purposes and radioactive iron for indicator experiments were produced simultaneously.

Wilson and Kamen have used instead iron phosphide for bombardment and have inserted this, mounted upon a water-cooled copper plate, between the 'dees', through the south window of the Berkeley cyclotron; the design and disposition of the Berkeley cyclotron having become something of a prototype, no further explanation with regard to the point of the compass is, perhaps, necessary. They found that they were able to obtain currents of incident deuterons of 150–200 microamperes, and at the same time the beam drawn by the deflector from the 'dees' and arriving in the target chamber was decreased by only 10 per cent. By inserting the target farther between the 'dees', incident ion currents of more than six hundred microamperes were obtained.

Using this technique, Wilson and Kamen have succeeded in obtaining ten millicuries of radioactive phosphorus in the course of a day.

A further advantage of the use of internal targets is derived from the fact that the ion current density is higher within the 'dees', and thus for a given yield it is necessary to expose a much smaller area of target than in the case of bombardment in the target chamber. Thus the ratio of radioactive to inactive phosphorus is enhanced, a definite advantage for therapeutic purposes where it may not be desirable to administer large quantities of inactive phosphorus. Wilson and Kamen are confident that specimens of several millicuries per milligram of phosphorus can easily be prepared.

The possibility of using neutron irradiation for the treatment of cancer has been one which has long attracted the attention of Prof. Lawrence, and two years ago, in collaboration with his brother, Dr. John Lawrence, and Mr. P. C. Aebersold, he published the results of a comparative study of the effects of X-rays and neutrons upon healthy and malignant tissue. From these it appeared that, for a given lethal dose with respect to normal healthy tissue, neutrons were quite as effective as X-rays in destroying malignant cells and indeed might even be more efficacious to the extent of some 20–30 per cent. These experiments were carried out on mice, using transplanted sarcoma tumours. The results were sufficiently encouraging for experiments to be planned on a clinical scale, and the new cyclotron was designed with this in view.

Before such experiments could be carried out, however, it would be necessary to obtain a collimated beam of fast neutrons which could be directed upon that locality which it was desired to irradiate. The satisfactory solution of this problem has been reported by Aebersold and Prof. Gladys A. Anslow at the New York meeting of the American Physical Society last February. Essentially, the fast neutron beam was obtained by means of an air channel through a water tank, the depth of water being sufficient to reduce the velocities of the neutrons and also appreciably to absorb them. A certain intensity of unabsorbed slow neutrons will, however, not be detrimental, since the biological action of neutrons is chiefly by reason of the heavy ionization produced by the proton recoils from fast neutrons. In order to eliminate gamma-radiation originating in both the water tank and the source, Aebersold and Anslow surrounded their channel and covered the outside walls of the water tank with lead and filtered the beam of fast neutrons through a slab of the same material. With the beam so obtained clinical treatment has already begun in Berkeley.

Further recent developments in cyclotron technique include an important contribution by L. W. Alvarez who, very ingeniously, by modulation of the cyclotron beam, has been able to produce monochromatic beams of neutrons of thermal energies. The method is essentially similar to that which has been developed independently by G. E. F. Fertel, P. B. Moon, G. P. Thomson and C. E. Wynn-Williams, and which was the subject of a recent letter in NATURE (142, 829; 1938). Bursts of neutrons were produced, in the former case by modulation of the radio-frequency input to the cyclotron, and in the latter by modulation of the current in the ion source of a 300 kv. deuteron discharge tube. The resolution which has been obtained by Alvarez is not, however, so sharp as in the experiments with the discharge tube, a difference which can probably be ascribed to the fact that, in the case of the cyclotron, instead of a short sharp pulse of voltage being applied to the plates of the oscillator, modulation was effected by the use of 60-cycle A.C. after half-wave rectification. Under these conditions Alvarez reports that the cyclotron beam was incident upon the target for 25–30 per cent of each cycle, whereas in the case of the experiments of Fertel, Moon, Thomson and Wynn-Williams, the duration of the neutron pulse was limited to only 10 per cent of the cycle.

Alvarez has, however, quite adequately demonstrated the potentialities of his method, and any increase in resolution is probably merely a matter of experimental refinement if, and when, it may be required.

A question which has aroused some interest, although it has as yet little practical significance, is the difficulty which will arise when the energies of the ions produced in the cyclotron shall be so great as to cause a breakdown in the resonance condition, due to the relativistic increase in mass of the ions at velocities comparable with that of light. A deuteron having an energy of fifteen million electron volts or an alpha-particle having twice that energy will be travelling with velocities of a little more than a tenth of the velocity of light. The consequent increase in mass of about one per cent, due to relativity, will cause an increase in the time taken for a particle to describe the semi-circular path within the 'dees'. It will therefore tend to lag behind the electric field and will be lost from the beam.

By effecting a suitable increase in the magnetic field at large radii, the path of the ion can be decreased to such an extent that it will arrive in phase with the electric field, but such a magnetic field would necessarily have a defocusing effect upon the beam. In a recent paper, L. H. Thomas has suggested that the magnetic field should be made, not only to increase with radius, but also to vary periodically along the path of the ion. This latter variation in the magnetic field introduces a further focusing effect which will partially counteract the defocusing effect due to the increase of magnetic field at large radii, necessary to compensate for the relativistic increase in mass of the ions. Thomas shows that by this expedient it will be possible to attain to energies where the relativity effect is already appreciable.

In deciding between the relative merits of radium, X-rays and a cyclotron for medical purposes, there is a natural tendency to count the cost and to calculate possible yields of radioactive materials in terms of interest on capital expended. Already sources of radioactive sodium have been prepared

in Berkeley with a strength of several hundred millicuries using the ordinary technique of bombardment with deutrons in the target chamber; radioactive sodium, in the process of decaying to magnesium in the ground state, emits a gamma-ray of such energy as may dispose of the need for radium for some purposes. This, with the results of the investigations into the yields using internal targets, and the possibilities of neutron irradiation of malignant tissue, should be an added stimulus to those who are in favour of the immediate construction of a cyclotron for medical purposes in Great Britain, believing that active research alone, with the most recent techniques available, is the necessary preliminary to any further progress in the treatment of cancer.

There are now some twenty-six cyclotrons, either operating or under construction, in various parts of the world. At Berkeley there are two cyclotrons, one belonging to each of these two categories. In addition, cyclotrons are running, or have been running, at the following places: Ann Arbor, Michigan; Cambridge; Copenhagen; Ithaca, New York (Cornell); Leningrad; Princeton; New York (Columbia); Rochester, New York; Swarthmore, Pennsylvania (The Bartol Foundation of the Franklin Institute); Tokyo; Urbana, Illinois.

Cyclotrons are also under construction at Birmingham; Bloomington, Indiana; Cambridge, Massachusets (Harvard University and Massachusets Institute of Technology); Chicago; Columbus, Ohio; Lafayette, Indiana (Purdue); Liverpool; Montreal (McGill); New Haven, Connecticut (Yale); Paris; Seattle, Washington; Stockholm.

The conclusion of this article on the cyclotron would, indeed, be inappropriate without a tribute to Prof. Ernest Lawrence, through whose imagination and experimental skill this valuable tool has been placed in the hands of the experimental physicist.

North Rona: a North Atlantic Island*

By Dr. F. Fraser Darling

MAN has such little interest in Rona that this island of less than half a square mile has disappeared from many maps of Scotland. It lies about forty-five miles north-east of the Butt of Lewis and north-west of Cape Wrath. The island is completely rockbound, the cliffs varying from a few feet to 355 feet in height. The continual Atlantic swell makes landing difficult and often impossible.

Rona is a northern outpost of the Hebridean hornblende gneiss intersected by several veins of pegmatite. Botanically, the island is distinct from the Hebrides. The northern end of Lewis is a vast peat bog which grows a characteristic herbage complex dominated by heather (*Calluna*). But there is no peat on Rona. The rock is covered with a thin layer of soil held together with a good turf of Yorkshire fog (*Holcus*), bents (*Agrostis*), sheeps' fescue (*Festuca*). Sedges (*Carex*) are rare on Rona, occurring only to the west of the ancient village site, where the turf has been cut for fuel hundreds of years ago. There are no permanent pools of fresh water on Rona. A well for seepage has been chiselled in the solid rock at the edge of the cliff in Poll Heallair on the south side of the island and it holds about ten gallons.

The drier rocky places are covered with a wealth of sea pink (*Statice*) and buckshorn plantain (*Plantago*); the cliff edges, heavily manured by the summer population of birds, grow luxuriant sprays of scurvy grass (*Cochlearia*), some sheep sorrel (*Rumex*) and mayweed (*Matricaria*). The village area with its lazy beds grows wild white clover (*Trifolium*) on the dry banks of conserved soil, and in the immediate vicinity of the ancient dwellings, silverweed (*Potentilla*) almost crowds out everything else. There is no bracken, fern or spleenwort, and few of those flowers which make the northern lands gay in May and June.

The whole of Rona is washed by salt spray in winter gales, but the northern peninsula of Fianuis is often impassable under a continuous driven cloud. Only plants with a high tolerance of salt can grow there—annual poa grass (*Poa*), sea pink, sea milkwort (*Glaux*) and chickweed (*Cerastium*).

So far as we know, St. Ronan was the first human inhabitant of Rona, in the eighth century A.D. He moved to Rona from Eoropaidh at the north end of Lewis and adopted the name of the island as his own. Thus we gather that Rona, *ron-y*, has been the island of seals for a very long period. The cell of St. Ronan still remains in a fair state of preservation, and I have done some

* Substance of a Friday evening discourse delivered at the Royal Institution on January 20.

FIG. 1. CHAPEL (LEFT) AND CELL OF ST. RONAN (RIGHT) SHOWING RESTORATION OF SOUTH WALL.

excavation and slight restoration (Fig. 1). The east and west walls of the cell inside are almost perpendicular, but the longer north and south walls slope inwards rapidly, and at a height of more than 11 ft. are 18 in. apart. Rectangular slabs of gneiss are placed across the top to finish the roof. The length and breadth of the cell at floor-level are 11 ft. 6 in. and 8 ft. Earth and stones were banked high round the outside of the north, east and south walls so that the building was practically underground.

The outside west wall became the east inside wall of a chapel which was built some time after Ronan's cell. This building, also in dry-stone but of poorer workmanship, is 14 ft. 8 in. by 8 ft. 3 in. and forms in effect a nave to the cell as chancel, though it is doubtful whether the two buildings were used conjointly as such. A block of masonry was laid bare on each side of the doorway into the cell and at the foot of these piers, which were taken to be the supports for the wooden altar in the later chapel (described by Martin Martin in 1703), a rough paving was found leading into the cell. The paving of the cell has been completely cleared at the eastern end, revealing an altar of well-built masonry 2 ft. 6 in. high, 3 ft. broad and 2 ft. 3 in. deep. A polished stone, rather smaller than a man's fist, was found at the foot of this altar and it appears to be of the same rock as Iona green marble, a rock entirely foreign to North Rona.

The first written mention of Rona and its people was made in 1549 by Sir Donald Monro, High Dean of the Isles, and later we read from Martin Martin of the life of the five families: "They covet no wealth, being fully content and satisfied with food and raiment; though at the same time they are very precise in the matter of property among themselves; . . . they take their surnames from the colour of the sky, rain-bow and clouds". A plague of rats came ashore from a wrecked ship between 1680 and 1690 and ate up the whole sustenance of the people, who then starved to death. The half-underground dwellings remain and it is evident they were entered by low and devious passages which would baffle the wind, which is an all-important factor in life on Rona. Several quern stones were found about these dwellings and two fragments of stone vessels.

Rona is an important sea-bird station. The guillemot population is approximately 12,500 pairs; kittiwakes are equally numerous and the puffins are countless. There

Fig. 2.

BRIDLED GUILLEMOT WITH PLAIN MATE.
13·2 per cent of common guillemots on North Rona are bridled.

are about 750 pairs of razorbills and 600 pairs of fulmar petrels. A population of at least 500 pairs of great black-backed gulls is predatory on the puffins. Storm petrels are numerous, and Rona is one of the three British breeding stations of Leach's fork-tailed petrels. Arctic terns and black guillemots also breed on the island. There is a resident flock of 300–400 starlings. Many interesting migrants visit Rona on their spring and autumn passage—flocks of white wagtails, of waders such as knots, sanderlings, dunlins and redshanks. Turnstones may be resident. There are such occasional visitors as the corn is now largely fed to the cattle in the straw.

The annual association of the seals with the land for reproductive purposes is their time of greatest danger, and the social system of the animals has become finely adapted for lessening this danger of the sea's edge. The seals are migrating to the island throughout August, but on arrival they do not come farther ashore than outlying skerries and ledges at the foot of the cliffs. Behaviour alters early in September, when mature bulls come on to the main mass of the island, as far as 300 yards inland, and lie quiet and alone

Fig. 3.

ATLANTIC GREY SEALS ON A LEDGE AT THE EDGE OF THE SURF.

green sandpiper, spotted redshank, short-eared owl, buzzard, hen harrier, woodcock and great snipe. Although the island has a good turf, neither grey lag nor barnacle geese winter there.

North Rona is the headquarters of the Atlantic grey seal, *Halichoerus gryphus* (Fig. 3). Protection by law has helped the species to recover from the low numbers brought about by the careless hunting in the nineteenth century. There is also the fact that the advent of rubber for sea boots and paraffin for light have made it unnecessary for the Hebridean to use sealskin and blubber. Crofters' cattle are now better fed, and no longer receive seal oil in the winter since threshing of the peoples' own oats has declined and the by small pools of brackish water. Bulls in adjacent territories make no attempt to impinge on each other's ground, but throughout the breeding season there is a traffic of bulls coming up from a neutral reservoir at the sea's edge, and these challenge the bulls in possession. The winner stays and the loser returns to the neutral ground, where all challenging behaviour is laid aside.

Cows come ashore about a week later than the bulls and, by the cows' freedom to move where they will, it appears that the territories of the bulls are most decidedly entities of space and not of numbers of cows within that space. The matings take place 11–14 days after the birth of the calves, so the bulls have been ashore then at least three

weeks without any cows having been in season. The maiden cows and a few old cows without calves collect on the surf-ringed skerry of Loba Sgeir and mate there with young bulls. It was exceptionally interesting to observe that all these animals lay cheek by jowl without any apparent expression of territorial behaviour. The young stock does not come inland.

After the breeding season a large proportion of the adult stock gathered on Loba Sgeir and lay quiet there until they had moulted their coats. They leave Rona then to feed about the Hebridean coasts until the next season.

The Atlantic grey seal calf is thin when born but puts on fat at a very rapid rate. Its fluffy white coat begins to be shed at a fortnight old and it is then that lactation in the cow rapidly declines and maternal care ceases. The calves face starvation until they reach the sea, and from a cliff-bound island that journey is a perilous one.

The occupation of the northern peninsula of Rona by the seals affects the vegetative complex and creates a favourable environment for Chironomid larvæ. Thus the island is a fruitful port of call for migrant birds and a place of immense consequence to many others. In any attempt to conserve our country's wild life we should not forget the little islands, for they have a value as sanctuaries far beyond that which their size would indicate. Rona, where man has failed to survive, is one of the great cities of this earth.

Scientific Approach to Milk Policy

MANY members of the British Association for the Advancement of Science have been feeling during the past three or four years that more efficient machinery should be devised by the Association for the consideration of the effects on society of scientific developments and discoveries, and for the application of scientific methods to social ends. At the Cambridge meeting of the Association in August last, it was decided to constitute a new Division of the Association to be concerned with social and international relations of science, and Sir Richard Gregory was elected the first chairman. It was later decided that the Division should hold meetings, at times intermediate between those of the normal annual meetings of the Association, at different centres in Great Britain and elsewhere.

The Nutrition Sub-Committee of the new Division has been the first to get off the mark, and, at the University of Reading on March 28, held a one-day conference on milk, in its nutritional and allied aspects. It is a commonplace that the handling of the milk question is the most awkward problem in any long-range policy concerned with improvement either in general health or in agriculture, and the boldness of the young Division in firmly grasping this important domestic nettle at its first meeting is a good augury for its future activities. In view of the trying weather, the attendance (about 180 were present at the main session) cannot be regarded as other than satisfactory.

The day began with a visit of the more weather-resistant members to the National Institute for Research in Dairying at Shinfield near Reading. Here the party was shown, by the Director and staff, experimental work on various *ad hoc* dairy industry questions, and also on some of the more fundamental problems of dairy science. Amongst the investigations described were those on the protein requirements of dairy cattle, on new methods for the pasteurization of milk, on the effect of various types of commercial processing on the nutritive value of milk, on the causes of low compositional quality in milk, and on the hormonal control of lactation. The new chemical and physiological laboratories now rapidly approaching completion, and the completely rebuilt dairy machinery testing centre were inspected, and the memorial library and the recently founded Imperial Bureau of Dairy Science visited.

After lunching at the University, members met for the afternoon session in the Great Hall, where the Vice-Chancellor (Sir Franklin Sibly) welcomed the Association on behalf of the University. The chair was taken by Sir Richard Gregory, who introduced the three principal speakers, Dr. Harriette Chick, Prof. J. C. Drummond and Dr. A. W. Scott. The papers given by these three dove-tailed so closely into one another that it is more convenient in this brief report to deal with them together.

The factual basis for the emphasis which has been laid on the importance of milk in the national dietary was re-described, and the food value of milk products, for example skim milk, was discussed. Despite its food value, milk is rather an awkward material to handle and distribute, and a potentially dangerous material for the consumer if it is not properly produced and processed. Whilst Great

Britain lingers rather far behind several other countries (such as Sweden, Switzerland, Norway, the United States), in liquid milk consumption per head, yet when dairy products such as butter, cheese, cream, dried milk, etc., are taken into account at their liquid milk equivalent, our consumption of liquid milk plus milk products puts us in a high position on the list, the consumption having increased from 322 kgm. per head per year in 1925–29, and 403 kgm. in 1930–31, to 548 kgm. in 1934. The dietetic value of milk is practically unaltered by properly controlled commercial pasteurization, and little affected even by sterilization and drying. This recent conclusion is the result of carefully controlled feeding and other experiments carried out at the National Institute for Research in Dairying and at the Rowett Institute, and also in elementary schools in England during the past four years, under the auspices of the Milk Nutrition Committee (chairman, Lord Astor). These findings and those obtained by other responsible investigators have finally disposed of the fallacy that commercial methods of pasteurization seriously damage the food value of milk. Kon has shown that one of the most labile constituents of milk, vitamin C, is, in milk, actually more sensitive to light than to heat, though milk is, in any event, a poor source of this vitamin. In view of the potential danger of drinking raw milk, exemplified from the health records of past years, which show how much ill-health is directly traceable to an infected milk supply, it was stated that no good scientific reason exists why the pasteurization of all milk for liquid consumption should not now be enforced.

The implications of such a policy were dealt with in some detail. A very large proportion of the milk supply of Great Britain is already heat-treated, but frequently inefficiently heat-treated, so that disease organisms are not completely destroyed, though the keeping quality of the milk may be improved. One of the advantages of compulsory pasteurization would be that supervision of commercial heat-treatment could be made much more efficient than at present, particularly now that the phosphatase test is available. Objections to compulsory pasteurization on the grounds that it would lessen the stimulus to the eradication of disease in dairy herds, or that it would cause farmers to relax their efforts towards clean milk production, or that it would put the whole industry in the hands of the large distributing combines, were stated to be without foundation. With reference to this last objection the control of the industry is now, in fact, in the hands of the largest possible combines—the producers' marketing boards.

Following the principal speakers, there was a short discussion. One of the most important points in favour of compulsory pasteurization was made during the discussion—namely, that it would actually help the producer by increasing public confidence, and the confidence of medical men (who in matters of nutrition are frequently the mentors of the public) in the safety of the milk supply. A rather loosely worded resolution was passed by the divisional meeting, for consideration by the Council of the British Association, recommending that pasteurization of all milk to be sold in their areas should be enforced by all authorities dealing with a population of 20,000 or above.

It would perhaps be an exaggeration to say that this resolution is battering at an open door. It is no secret that the big producers' organizations in Great Britain are not opposed to compulsory pasteurization at least as applied to the large municipal areas, with a stipulation that a supply of raw tuberculin-tested milk should be available for those individuals who really prefer raw milk. The Government too, in 1938, accepted the principle of compulsory pasteurization and had incorporated it, with certain safeguards, in the very comprehensive and well-thought-out Milk Industry Bill, which was withdrawn a few months ago. That the withdrawal was on account of the compulsory pasteurization clauses seems highly unlikely.

Quite apart from new legislation, however, a suggestion, admittedly not novel, was made informally after the meeting which, if put into action, might greatly ameliorate the risk, from the consumer's point of view, of milk-borne disease. Heavy penalties could presumably be exacted at common law from any retailer who had sold milk which could be proved to have caused disease in the consumer; if this were done in one or two cases, it is not unreasonable to suppose that raw milk distributors themselves would feel disinclined to continue to risk not merely the consumer's health, but also their own reputation, trade and pocket, by selling unsafe milk in the future.

During the evening session, the chair was taken by Sir Daniel Hall, and two papers, one by Mr. James Mackintosh on milk production, and the other by Mr. John Cripps on milk distribution and costs were given. The main problem of increased production in Great Britain to meet a steadily increasing demand for liquid milk was stated to be, at least in the early stages of this demand, that of increasing the winter supply, which in November, December, and January is at present very close to the minimum required to cover the needs of the liquid trade.

It would be possible to even out supplies during the year by arranging for more cows to calve in autumn. Again, far better yields per cow than those obtained at present are possible in many herds by making use of knowledge already available

on feeding and management, and on methods of breeding. In urban distribution, it was pointed out that the consumer is suffering under a surfeit of retailers, many of whom could be dispensed with, and of 'services' many of which are quite superfluous with properly processed milk. If surplus retailers and these costly but unnecessary services could be dispensed with, consumer prices could be reduced. But without monopoly in some form or another, it is not easy to see how a stable scheme for effective and minimum-cost distribution could be brought about. It was suggested that, instead of further verbal discussion of hypothetical alternatives, some experiments on different types of monopoly control, for example, municipal, co-operative, public utility, private firm, ought to be tried out under careful supervision in limited areas. But this type of experiment cannot take place without legislation.

From the events of this most interesting day, one point emerges very clearly. This Division of the British Association by its very nature cannot proceed far without becoming involved, and involved very deeply, in politics and in active social planning. While this is well understood by the officers of the Division, it seemed to be somewhat of a revelation to several of those others who attended the Reading meeting.

Obituary Notices

Miss Dorothea F. M. Pertz

DORA PERTZ, who died on March 6, a few days before reaching her eightieth birthday, was born in 1859 into a cosmopolitan, intellectual milieu, for which it would be difficult to-day to find a parallel. Her father was Dr. G. H. Pertz, a scholar of world-wide repute, and Royal Librarian in Berlin. His first wife was a brilliant Englishwoman, who counted Sismondi and Lafayette among her friends. His second wife, Dora's mother, also an Englishwoman, was one of a remarkable group of sisters, the six daughters of Leonard Horner, a prominent early member of the Geological Society, and twice its president. He was evidently a man of unusual breadth of view, for though he was born at so remote a date as 1785, he was sufficiently open-minded to commend Darwin's speculations in his last address to the Geological Society in 1861. Horner's eldest daughter was married to Sir Charles Lyell, and his second daughter to Sir Charles J. F. Bunbury, a botanist, who, under Lyell's influence, turned his attention to fossil plants.

Among the Horners, scientific enthusiasm was by no means confined to the men. Dora Pertz's grandmother helped her husband with his rock collections, and when the meetings of the Geological Society were first thrown open to women visitors, Dora's aunts, Lady Lyell and her sisters, were constant in their attendance, though otherwise few women cared to avail themselves of this privilege. Katharine Horner, who married Lyell's brother, and eventually became the biographer of her father and her brothers-in-law, was a botanist. She published in 1870 "A Geographical Handbook of Ferns"—a highly technical catalogue dealing with the distribution of this group. Of Sir Charles Lyell, in his Harley Street period, Dora had certain childish recollections, especially of occasions when he would call a hansom cab and carry off his two small nieces for rapturous visits to the Zoo. Love of animals was throughout Dora's life a ruling passion, and her youthful memory of visiting the Darwins at Down, centred in the joy of being allowed to caress the nose of the horse on which Charles Darwin was riding, in his cloak and broad-brimmed hat.

When her father died, Dora Pertz went with her mother and sister to live in Florence, but, after some years in Italy, the family urge towards science brought her to England in 1882, in order to enter Newnham College. Having taken honours in the Natural Sciences Tripos, she continued to work at Cambridge, doing research in plant physiology under the direction of Francis Darwin, who was then a member of the staff of the Botany School. Dora Pertz co-operated in much of his work, and also produced several independent papers. The best known of their joint memoirs is probably that "On the Artificial Production of Rhythm in Plants", published in the *Annals of Botany* of 1892. She also did some genetical work in the days when that study was just beginning at Cambridge, and collaborated with William Bateson in a paper on inheritance in *Veronica*.

After Sir Francis Darwin's retirement, Dora Pertz continued for a time to make observations; but she came to recognize that the plant physiology of the twentieth century was developing on lines widely divergent from those on which she had been educated, and that it demanded a grasp of mathematics, physics, and chemistry, which she did not possess. With characteristic clear-sightedness as to her own limitations, she desisted from attempting to do research for which her equipment was inadequate, and she sought for some other means through which she could be of use to botany. Fortunately, Dr. F. F. Blackman was able to enlist her services in cataloguing pamphlets, and in making an elaborate index of the papers of plant physiological interest in the numerous early volumes of the *Biochemische Zeitschrift* and the *Zeitschrift der physiologischen Chemie*. She completed the index up to the year 1935; the magnitude of the task may be judged

from the fact that in the *Biochemische Zeitschrift* alone she had to deal with 268 volumes. A letter of appreciation of this work from the members of the staff of the Sub-Department of Plant Physiology gave her special pleasure in her last illness. Concurrently with the work on the index, she found scope for her considerable powers of draughtsmanship in making all the illustrations for a long series of papers on floral anatomy published by her friend Miss E. R. Saunders, between the years 1923 and 1936.

Over a very long period—indeed until the failure of her health brought all activities to a close—Dora Pertz was content to give her time with complete steadiness and regularity to indexing and drawing, though these somewhat mechanical occupations could not, in the nature of things, have for her the compelling charm of her own chosen work. In her absence of personal ambition, and the disinterestedness of her desire to be serviceable to botany, Dora Pertz was true to the family tradition handed on to her by Horner, Lyell and Bunbury; she was one with them in pursuing science simply for the love of it, and in being—in the basic sense of that much mishandled word—an amateur. AGNES ARBER.

Dr. Moses Gaster

WE regret to record the death of Dr. Moses Gaster, the distinguished Jewish scholar, historian, and folklorist, formerly Chief Rabbi, which took place suddenly on March 5 at the age of eighty-two years.

Moses Gaster was born in Bucharest on September 16, 1856. He was the son of the Chevalier A. E. Gaster, and a member of a family which for long had been settled in Rumania. He graduated at the University of Bucharest and received the degree of Ph.D. from the University of Leipzig and the rabbinical diploma from the Jewish Rabbinical Seminary at Breslau. On his return to Bucharest in 1880, after a period of literary activity, he became lecturer on Rumanian language and literature at the University of Bucharest and inspector-general of schools, holding in addition other public offices; but his activities in connexion with the settlement of Jews in Palestine led to his inclusion among the Jews expelled from Rumania at this time at the instance of Russia. Dr. Gaster then settled in England, where his work as Ilchester lecturer in Greco-Slavonic languages in the University of Oxford rapidly secured him a place in the front ranks of scholarship.

Dr. Gaster was the author of a large number of works on Jewish historical subjects, as well as in the more advanced Hebrew and Rabbinical studies. As a folklorist he inevitably came to be regarded as the first authority in Great Britain on the folk-lore of Rumania; but his interest in folk-lore studies was by no means confined to either his country of origin or to his special field of Jewish scholarship. His wise counsel and ready ability in suggestion were ever at the service of his fellow workers. Among his publications may be mentioned as of special interest to students of folk-lore and comparative religion "Rumanian Bird and Beast Stories", "Studies and Texts in Folklore, Magic, Medieval Romance, Hebrew Apocrypha, and Samaritan Archæology", "The Samaritans", embodying the Schweich Lectures of 1925, and "The Sword of Moses" an early Jewish magical work which had been lost for a thousand years until discovered and published by him.

On the cancellation of his order of expulsion Dr. Gaster paid several visits to Rumania and for a report on the English educational system, published as a Rumanian State paper, and other services he received the Rumanian Order of Merit of the First Class.

Dr. Antoine Béclère

DR. ANTOINE LOUIS GUSTAVE BÉCLÈRE, the pioneer of medical radiology in France, died at the age of eighty-two years on February 24 in Paris, where he was born on March 17, 1856, the son of a general practitioner, and received his medical education.

Béclère qualified in 1882 with a thesis on the contagion of measles and at first took a keen interest in other infectious diseases, especially smallpox—for which in collaboration with Chambon and Ménard he introduced treatment by convalescent serum—vaccinia and syphilis. Shortly after the discovery of X-rays in 1895 he became engrossed in the study of radiodiagnosis and radiotherapy, and at his own expense fitted up a radiological laboratory at the Hôpital Tenon in 1898 and started a course of free instruction in medical radiology which he resumed in 1899 after his transfer to the Hôpital Saint Antoine and continued until his retirement in 1921.

During the Great War, Béclère was director of a radiological centre at the Val de Grâce military hospital. In addition to numerous communications to medical societies and journals, he was the author of works on "Röntgen Rays in the Diagnosis of Tuberculosis" (1899), "Röntgen Rays in the Diagnosis of Non-Tuberculous Diseases of the Chest", several articles in the treatise of medical radiology edited by Prof. Bouchard (1904), and "Röntgen Rays in the Diagnosis of Internal Diseases" (1904).

Besides being Commander of the Legion of Honour, Béclère received many well-merited distinctions. In 1928 he was elected president of the Académie de Médécine, of which he had been made a member in 1908. He was also one of the first members of the recently resuscitated Académie de Chirurgie. In 1931 he was president of the third International Congress of Radiology held in Paris, and the same year he was elected an honorary fellow of the Royal Society of Medicine. On attaining his eightieth birthday in 1936 his pupils, colleagues and friends dedicated to him a jubilee volume in which his contributions not only to radiology but also to pædiatrics, experimental medicine, neurology, endocrinology, diseases of the chest, diseases of the abdomen and gynæcology formed the subjects of appreciation by well-known specialists. The journal *Strahlentherapie* also devoted a *Festschrift* to him on the same occasion. During the last years of his life, he resumed his study of vaccinia and syphilis.

J. D. ROLLESTON.

News and Views

National Service Committee for Scientific Research

THE Central Register Advisory Council of the Ministry of Labour has appointed the following Committee for Scientific Research: A. V. Hill (chairman); C. G. Darwin (mathematics); E. V. Appleton (physics); J. C. Philip (chemistry); R. V. Southwell (engineering sciences); E. B. Bailey (geology); V. H. Blackman (botany); D. M. S. Watson (zoology); A. V. Hill (physiology); W. W. C. Topley (pathology); F. C. Bartlett (psychology); Director of Scientific Research, Admiralty; Director of Scientific Research, War Office; Director of Scientific Research, Air Ministry; Department of Scientific and Industrial Research; Medical Research Council; Agricultural Research Council. Ten sub-committees for the consideration of the several subjects have been co-opted.

Broadcasting by Telephone

THE Postmaster-General announced in the House of Commons on March 30, that the Post Office is to proceed immediately with the introduction of a system of distributing broadcasting programmes over the line telephone network. This service will be additional to that of the existing relay companies, the licences of which will also be extended for a further period of ten years to December 31, 1949. The new telephone broadcasting service will be operated on the so-called 'wired wireless' or carrier-current system, which is already in use to some extent in Great Britain and other countries for ordinary line telephony; a radio frequency carrier current, with the appropriate programme modulation, will be transmitted over the telephone lines, and a complete wireless receiving set will be used at the subscriber's end of the line. Three or four alternative broadcast programmes will be provided, the selection to be carried out by adjusting the receiver, and it will be possible to use the telephone simultaneously with the reception of a broadcast programme. The new service will be restricted at first to telephone subscribers, and the question of its extension to non-subscribers will be deferred pending experience of its working. From the point of view of national defence, the new service will have the advantage over the existing broadcasting system of reduced liability to interruption or interference; it is not intended, however, that any restriction shall be placed upon the wireless broadcasting programme service at the present time. The existing relay companies transmit merely the audio frequency currents over a special line network to loud-speakers on the subscribers' premises, and the service is usually limited to a choice between two programmes provided from the relay exchange. The new licences issued to these companies will require that these exchanges shall be connected to a B.B.C. station by wire, and that in time of emergency they shall transmit any special announcements ordered by the local A.R.P. or police authorities.

H.M. Aircraft-Carrier *Ark Royal*

THE annual session of the Institution of Naval Architects, was held in the Royal Society of Arts during March 29–31. Lord Stonehaven, the president of the Institution, reviewed the events of the last year in his opening address. Sir Stanley Goodall, Director of Naval Construction for the Admiralty, then read an interesting paper describing H.M.S. *Ark Royal*, the first ship to be designed exclusively as an aircraft carrier. As it is not the function of this type of ship to fight a gun duel, its armament consists mainly of aeroplanes. The ship carries a few guns capable of both high angle and low angle fire. She has a heavily armoured deck, side-armour adequate against medium guns, and improved underwater protection. 103,000 horse-power on three shafts gave her a speed in trials of 31¾ knots and special attention had been given to rapid manœuvring. The auxiliary machinery is both electric and hydraulic. Special aircraft fittings include two catapults at the fore end of the flying deck, arresting wires at the after end for aircraft landing on it, hydraulically operated wind screens which fold down flat when necessary and three two-story lifts which take aircraft with their wings folded. Electric welding was used extensively in her construction, and this lessened her weight by 500 tons. In the discussion which followed the paper Sir George Preece, engineer-in-chief to the Navy, said that owing to the necessity for rapid manœuvring it was found necessary to have two engineers of the watch, one for general control and one for direct supervision. The large rudder immediately abaft the centre propeller was invaluable when turning at rest. In the last cruise, 1,400 aircraft landings on deck had been made without a scratch. 'Landing on' had proved safer than driving a car on an English road.

Emergency Medical Arrangements for War-Time

PREPARATIONS for dealing with casualties in the event of war are now well advanced. The Ministry of Health has issued circulars to local and other authorities under the Air-Raid Precautions Act, 1937, indicating the organization of emergency ambulance services, and of first-aid posts (Circulars 1787 and 1789. H.M. Stationery Office. 2*d*. and 3*d*. net, respectively). An emergency Hospitals Scheme for London has also been prepared. This scheme is based on the affiliation of certain casualty hospitals in the more vulnerable areas to others in outer areas. In London this affiliation is arranged in ten sectors radiating from the centre. Each of these sectors contains voluntary and municipal hospitals of widely differing types, including the great teaching hospitals, local authority institutions, mental hospitals, specialized hospitals, cottage hospitals, and others. It is proposed that the casualty hospitals near the centre of each sector should be used so far as possible for immediate treatment only, and that the injured

should be transferred at the earliest opportunity from the centre to affiliated casualty base hospitals in the outer areas.

The Palæontographical Society

AT the annual meeting of the Palæontographical Society held in the rooms of the Geological Society on March 31, the Council reported that the Society's ninety-first annual volume had been issued during the past year. This volume contains the first part of a new monograph on the Carboniferous Rugose Corals of Scotland by Dr. Dorothy Hill. Largely based on the extensive and oft-quoted material studied by James Thomson and afterwards disorganized by the fire in the Kilmarnock Museum in 1909, this monograph introduces considerable simplification in systematic nomenclature. Further instalments of the monographs on Cambrian trilobites by Mr. P. Lake and on corallian ammonites by Dr. W. J. Arckell are also included in this volume. The work of the Society in publishing illustrations and descriptions of fossils collected in Great Britain has been materially assisted by an allotment of £100, from the Government Publication Grant administered by the Royal Society, towards the issue of the monograph on corallian ammonites. Other donations mentioned in the report include sums of money received from the Colston Research Fund of the University of Bristol and from Miss Mary S. Johnston. Monographs which are also in progress include Pleistocene Mammalia (Prof. S. H. Reynolds), Cretaceous Belemnites (Prof. H. H. Swinnerton, Gault Ammonoidea (Dr. L. F. Spath), Great Oolite Brachiopoda (Dr. Helen Muir-Wood), Dendroid Graptolites (Dr. O. M. B. Bulman) and Palæozoic Asterozoa (Dr. W. K. Spencer). The following officers were elected for the ensuing year: *President*, Sir A. Smith Woodward; *Treasurer*, W. E. F. Macmillan; *Secretary*, Dr. C. J. Stubblefield.

Mayan Chronology: New Evidence

A JOINT expedition of the Smithsonian Institution, Washington, and the National Geographic Society, which is engaged in the excavation of a site at Tres Zapotes, in the State of Vera Cruz, southern Mexico (according to a communication issued by Science Service, Washington), has discovered a date monument which, it is anticipated, will settle a much-debated question of the authentic age of the reputedly earliest known dated Mayan object, and at the same time determine how and when the ancient Maya first spread over Central America. The site at Tres Zapotes, it is to be noted, is at least one hundred miles west of what had hitherto been believed to be the Mayan zone. Reports of the early results of excavation indicate that the site at Tres Zapotes is early; but the dating of the recently discovered monument is in the so-called 'short' style, which has generally been regarded as a late invention. Apart from its intrinsic interest, the question whether this style of dating was or was not in use in the early period of Mayan civilization is of importance in its bearing on the age of the famous jade statuette of a priest now in the National Museum, Washington. This statuette bears a dating equivalent, on the Spinden correlation, to May 16, 98 B.C., and if this be taken at its face value, the statuette is the oldest known dated Mayan object. The date, however, is written according to the 'short' system, and question, therefore, has been raised whether the dating is contemporary, or was added in a later period, or whether, indeed, the statuette itself may not be an archaistic piece. Dr. Matthew W. Stirling, who is in charge of the excavation, has summoned a conference of archæologists to be held on the site, to discuss whether they confirm his conclusion that the newly discovered monument is 'early'.

Eoliths

A COMMUNICATION from Mr. A. S. Barnes traverses the arguments put forward by Mr. J. Reid Moir for the human origin of the pre-Crag implement (see NATURE of January 28, p. 151) and deals *seriatim* with the characters upon which he relies. The problem of the differences between natural and human flaking is discussed by Mr. Barnes at length in the current issue of the *American Anthropologist* (**41**, 1, 1939, p. 99). He there maintains that the arguments for the human origin of pre-Crag implements are for the most part purely subjective, while it has been shown that purely natural forces are able to produce flaking similar to that on eoliths, and further, that the flaking on eoliths differs from that on human work. Although attempts have been made to formulate objective differences between the flake detached by man and those detached by natural agencies, such as 'resolved flakes' and flakes with certain other characteristics, these effects, Mr. Barnes holds, are found on flake fractures by fortuitous pressure as well as by man. After recapitulating the factors operating in natural and artificial fracture, Mr. Barnes goes on to suggest that a criterion of human workmanship, readily measurable and common to both classes of flaking, natural and artificial, is to be found in the angle platform-scar, which he defines as the dihedral scar formed by the intersection of the surface on which the blow has been struck, or pressure applied, and the surface of the scar left by the flake removed. As the result of an investigation of a large number of specimens by this method it has been found that an industry, or supposed industry, may be regarded as of human origin if not more than 25 per cent of the angles platform-scar are obtuse, that is, 90° and over. None of the eoliths examined by Mr. Barnes complies with this criterion, and, he maintains, cannot therefore be considered to be of human origin.

Encouraging Inventions

THE Paris International Trade Fair will be held during May 13–29. An interesting feature is the Inventions Competition (Concours d'Inventions), which is open and free to every inventor. An invention of any type may be entered. It may take the form of a new apparatus or device or it may be an improvement which can be incorporated in existing machinery or material. There is a strict

limitation that the invention must not have been exhibited for any other competition. Each competitor must also attach to his entry form a copy of his patent specification, or, if the invention be not patented, a notice setting forth its aims and functions and, when possible, a résumé of its technical qualifications. If possible, actual models (in working order) are to be submitted, but if this cannot be done, permission may be obtained for their presentation by means of a plan. The jury decides whether the plan submitted is sufficiently explicit in itself to convey to experts, and to the public, a clear representation of the functions and operation of the invention. The total area allotted to each exhibit will as a rule not exceed one square metre, but by special application to the committee larger models may be exhibited. All inventions entered for the competition are displayed in a special hall for the duration of the Fair and should be forwarded so as to arrive not later than May 5, addressed Foire de Paris, Concours d'Inventions, Porte de Versailles, Paris 15. The exhibits are classified under many headings, including engineering, medical apparatus, domestic economy, games, travel and camping, office equipment, publicity and education. Competitors whose inventions are not patented may apply for a certificate of guarantee affording protection in France for a period of twelve months from the opening date of the Fair. Entry forms can be obtained at the London Office of the Foire de Paris, 17 Tothill Street, Westminster, S.W.1, and must be completed by March 31.

Combustible Material in Electric Power Stations

EARLY in this century, after a fire at Bristol, rubber-covered cables for switchboard work were rarely used. The recent inquiry on the fire at the Kingston Power Station should accelerate the demand for the use of non-combustible materials alone in main power stations. It was stated in evidence that about 850 gallons of inflammable oil and about 14,000 lb. of solid compound fed the flames. Fires due to oil have been perhaps more numerous in America and Germany than in Great Britain; but recent events show the necessity of getting control of a fire in a power station at the earliest possible moment. The modern oil circuit-breaker (switch) has proved very trustworthy in practice. At its rated capacity it will clear any electric faults with certainty; but in very exceptional circumstances it may fail. The chiefs of supply stations are now paying great attention to the problem of oil-less circuit breakers. Several foreign makers have for the last few years been successfully producing oil-less breakers, particularly the A.E.G. Co. in Berlin, the Brown-Boveri Co. and the Oerlikon Co. in Switzerland. The A.E.G. Co. manufactures a special breaker called a chemical resin breaker for service in unattended substations where the air-blast type could not receive adequate supervision and maintenance. A very profitable and urgent line of inquiry for the industrial research worker would be to try to discover non-combustible liquids and solids of high insulating value for transformers, switches and electric wires. Some fairly satisfactory liquids and compounds have been found, but their cost at present is far too high for use in bulk. It is all a matter of finance. Textile glass has recently been invented. It seems probable that as a wrapping for electric wires it will have a great future.

Agricultural Research and the Farmer

A BROADSHEET "Bringing Science to the Farm" issued by P E P (Political and Economic Planning) directs attention to defects in the present system of putting the results of agricultural research at the disposal of the farmer. Some of the difficulties are familiar in other attempts at the popularization of scientific discoveries, notably the superimposition of lecturing on research. Not only does such work impede actual research, but also research ability is by no means invariably linked to lecturing ability, and poor exposition may retard rather than help the spread of agricultural knowledge. The broadsheet urges a thorough overhaul of the provincial advisory service, which is not only seriously understaffed but has lagged behind the rapid diversification and specialization of the sciences concerned. Inadequate arrangements exist for liaison between the provincial advisers and research institutes not situated at their centre, or within their province as well as between the research institute and the farmer. The efficiency of the advisory service moreover depends primarily on the rateable value of the county and is controlled by the county agricultural committees, which cannot be expected to have the same scientific outlook and aims as the research and provincial advisory workers. County organizers do not always refer to the provincial advisers' problems which are beyond their own capacity, and the county organizer is often laden with many other duties besides advisory work. The broadsheet criticizes the annual reports of the research stations from the point of view of propaganda and also the manner of distribution of the official leaflets for farmers issued by the Ministry of Agriculture as well as the meagre use made of films, and lays special stress on the place of the educational services as the fundamental link between research and practice.

Colloquium on Sex Hormones

IN June 1937 a colloquium on sex hormones was held in Paris under the auspices of La Fondation Singer-Polignac. This colloquium was attended by men of science from France, Denmark, the United States, Canada, Great Britain, etc. The meeting lasted ten days, morning and afternoon sessions being held for the reading of papers on most days. The wide international representation of active investigators led to great interest being taken in the papers and to vigorous discussion. The papers presented, together with summaries of the discussions, were afterwards published in one volume for private circulation. They have now been republished in five numbers, each containing five papers, in the series of "Actualités Scientifiques et Industrielles" (Paris: Hermann et Cie). The first number appears under the general title "Les Propriétés des Hormones Sexuelles". The second number deals with "Ovula-

tion, Menstruation, Gestation". The third contains papers dealing with the pituitary. The fourth is entitled "Régulations générales. Influence des facteurs nerveux et externes"; and the fifth number contains papers on a variety of subjects such as pathology, toxicity, antihormones and cancer. The final publication of this material concludes the record of the colloquium, which will be long remembered by those taking part as a particularly happy and profitable occasion upon which La Fondation Singer-Polignac should be most heartily congratulated.

Lake District Roads

THE main object of the Friends of the Lake District is to have the Lake District made a National Park; but they insist on the necessity of guarding against the present tendency to undue development of motor-roads and motor-transport which would ruin the beauty and solitude of the district. The theme is developed at length in a pamphlet entitled "A Road Policy for the Lake District" published by the Friends of the Lake District, Ambleside. The essential Lake District is within a radius of some fifteen miles from the Langdale Pikes: this is the area that needs to be protected. There should be good motor-road access to this area and around it, but there should be no increase in the two or three good routes which go through this area. Moreover, in order to preserve the amenities, which give the Lake District much of its claim to preservation as a park, the width of roads should not be increased and through fast traffic thereby encouraged, dale-head roads which end in a cul-de-sac should not be made available for through traffic, and certain by-roads should be closed entirely to motor-traffic. The pamphlet discusses these matters at length as well as the good and bad examples of road widening that have already been carried out. Above all, it advocates a policy that suits the requirements and amenities of the district rather than a standardized national policy which has little or no relation to local requirements.

Insurance Against Natural Calamities

THIS is a matter which has received a considerable amount of attention from time to time, and here and there premiums against such risk have been accepted, but in general, however, such risks are not taken by companies except for abnormally high premiums, for the simple reason that the place, time and destructive energy of the phenomena cannot be foretold, nor do they occur with any regularity. The problem has been examined by H. Lanz-Stauffer (*Revue pour l'étude des calamités*, 1, No. 3; 1938). The first international conference on this topic, held in Paris on September 13–17, 1937, expressed the hope that research would be made into the problem of the application of the principles of insurance to natural calamities, an application considered until the present time not capable of realization. The author considers the problem from three different angles with regard to the Union Internationale de Secours: (1) with the Union as the insurer against the risk; (2) with the Union as the insured party against the risk; (3) with the Union encouraging in a general manner insurance against such calamities and contributing to its realization. The article may be commended to those concerned with insurance against damage by earthquakes, tornadoes and the like.

Earthquakes Recorded at Tokyo

WE have received the seismometrical report of the Earthquake Research Institute, Tokyo Imperial University, 1938, parts 1–2 (Jan. 1–June 30, 1938). This includes a first list of twelve stations attached to the Institute together with their latitude and longitude co-ordinates to the nearest second of arc, and their distances in kilometres from Tokyo. Following this is a table of twenty-two earthquakes sensible in Tokyo during the period under consideration. It would be an improvement if the headings to the columns in this table were given in English as well as in Japanese. Next is a map on a square of approximately 3° edge having Tokyo at the centre, showing the distribution of the epicentres. It is notable that these are elongated in a direction north-east–south-west, and otherwise fairly uniformly distributed. Eight are submarine and off the north-east coast of the main island of Japan. Finally there are twelve reproductions of seismograms from the Tokyo (Hongo) station for the shocks of February 7, May 23 and June 6, six being normal and six acceleration seismograph diagrams, all very well reproduced. The publication provides valuable data for seismological studies.

The Smithsonian Institution

THE report of the Secretary of the Smithsonian Institution for the year ended June 30, 1938, refers to the completion in June of two full years of the Smithsonian radio programme in co-operation with the United States Office of Education (Publication 3489. Pp. viii+117. Washington, D.C.: Government Printing Office, 1938). These educational broadcasts have covered the various fields of the Institution's activities—science, invention, history and art—and have been widely popular. An outstanding accession to the National Museum has been a collection of molluscs obtained through the Francis Lea Chamberlain fund, which numbered more than a million specimens. Numerous specimens were brought back for the National Zoological Park by the National Geographic Society–Smithsonian Expedition to the East Indies. The Bureau of American Ethnology dispatched an expedition to South America to make extensive studies of the Indian tribes of the western part of that continent. The Division of Radiation and Organisms has developed an improved method for measuring plant growth substances concerned in the bending of plants towards the light, as well as a new automatic apparatus for measuring and recording photosynthesis continually, and an apparatus for the determination of chorophyll. The Smithsonian solar observing station on Mount St. Katherine in Egypt was abandoned, and construction of a new station on Burro Mountain, near Tyrone, New

Mexico, was begun. The Astrophysical Observatory has undertaken the re-computation of all solar-constant values from 1923 to the present time.

Academy of Sciences of the U.S.S.R.

AT a plenary session of the Academy of Sciences of the U.S.S.R. recently held in Moscow the following officers were elected: *President*, V. L. Komarov; *Vice-Presidents*, O. J. Schmidt, I. M. Gubkin, E. A. Chudakov, A. A. Bogomolets, A. J. Vishinsky, T. D. Lysenko, V. N. Obraztsov, A. E. Fersman. The secretaries of the eight newly constituted departments of the Academy, elected at a previous session of the Academy, become *ex-officio* members of the Presidium. They are: Department of Economics and Law, E. S. Varga; Department of Technical Sciences, V. P. Nikitin; Department of History and Philosophy, A. M. Deborin; Department of Geology and Geography, P. I. Stepanov; Department of Biology, L. A. Orbeli; Department of Physico-Mathematical Sciences, A. N. Kolmogorov; Department of Languages and Literature, I. I. Meshchaninov; Department of Chemistry, A. N. Bakh.

Scholarships in Electrical Engineering

APPLICATIONS, which must be received not later than April 15, are invited for the following scholarships awarded by the Institution of Electrical Engineers: *Duddell Scholarship* (£150 per annum, tenable for three years), open to British subjects less than nineteen years of age on July 1, 1939, who wish to take up a whole-time day course in electrical engineering; *Ferranti Scholarship* (£250 per annum, tenable for two years), open to British subjects less than twenty-six years of age on July 1, 1939, who are students or graduates of the Institution and have been such for not less than two years, who desire to carry out whole-time research or postgraduate work of an electrical engineering nature; *Swan Memorial Scholarship* (£120, for one year), open to British subjects less than twenty-seven years of age on July 1, 1939, who have completed a recognized course in electrical engineering or science of at least three years, and who desire to carry out whole-time research or postgraduate work of an electrical engineering nature; *Silvanus Thompson Scholarship* (£100 per annum and tuition fees, tenable for two years) for works employees who are the sons of parents of limited means, open to British subjects less than twenty-two years of age on July 1, 1939; the successful candidate will be required to make up a whole-time day course in electrical engineering at an approved university or technical college. Further information can be obtained from the Secretary, Institution of Electrical Engineers, Savoy Place, London, W.C.2.

Announcements

PROF. JOEL H. HILDEBRAND, professor of chemistry in the University of California, has been awarded the Nichols Medal of the New York Section of the American Chemical Society.

M. BERNARD LYOT, of the Meudon Observatory, has been elected a member of the Section of Astronomy of the Paris Academy of Sciences in succession to the late A. de La Baume Pluvinel.

DR. J. M. STAGG has been appointed superintendent of Kew Observatory, Richmond, in succession to Dr. F. J. W. Whipple, who retired on March 31.

THE Masters Memorial Lectures of the Royal Horticultural Society will be delivered in the Society's New Hall in Greycoat Street, Westminster, on April 18 and 19 at 3.30 p.m. by Dr. J. C. Willis, on "How Plants have found their Homes".

AT a meeting of the Microchemical Club on March 11 the following officers were elected: *Hon. Treasurer*, Dr. L. H. N. Cooper; *Hon. Secretary*, Mr. W. F. Stephenson; *Hon. Librarian*, Miss I. Hadfield; *Members of Committee*, Miss M. Corner and Mr. J. R. P. O'Brien.

THE American Social Hygiene Association has awarded the 1939 William Freeman Snow Medal to Dr. Thomas Parran, Surgeon-General, United States Public Health Service, "for his great contribution to the health and happiness of the American People through his persistent efforts against syphilis and the conditions which favour its spread".

AN informal conference on "Internal Strains in Solids" will be held during July 11–13 at the H. H. Wills Physical Laboratory, University of Bristol, under the joint auspices of the Physical Society and the University of Bristol. The Conference is open to all members of universities or research institutions. Further information can be obtained from Prof. N. F. Mott, H. H. Wills Physical Laboratory, The University, Royal Fort, Bristol 8.

THE thirty-seventh annual meeting of the South African Association for the Advancement of Science will be held in East London during July 3–8, under the presidency of Prof. G. H. Stanley. The British Association Medal for 1938 will be awarded to Miss Jean Murray, of the Division of Plant Industry, Pretoria, for her paper entitled "An Investigation of the Inter-relationship of Vegetation, Soils and Termites". A symposium on "The Need for the Investigation and Conservation of Human Resources in South Africa" is being organized by Dr. E. G. Malherbe, director of the National Bureau of Education and Social Research, Pretoria. Further information can be obtained from the assistant general secretary, Mr. H. A. G. Jeffreys, P. O. Box 6894, Johannesburg.

In the ninth report of the Committee for Atomic Weights of the International Union of Chemistry, the only change proposed is the atomic weight of phosphorus, which is now taken as 30·98.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 605.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

The Time Involved in the Process of Nuclear Fission

BOHR[1] has discussed the process of nuclear fission in uranium and thorium under neutron bombardment on the assumption that a neutron is first captured by the nucleus and that later the energy of excitation of the compound nucleus is concentrated in motion of some special type which leads to deformation and ultimately to division of the system. From this point of view, it is of interest to try to obtain an estimate of the life-time of the compound nucleus before fission, and Green and Alvarez[2] have reported upon experiments with a modulated beam of neutrons produced in the Berkeley cyclotron which show that this life-time must be smaller than 3×10^{-3} sec. I have recently obtained evidence of an asymmetry in the spatial distribution of the fission fragments, in the case of uranium bombarded by fast neutrons, from which a limiting time very much smaller than this may be deduced. On the basis of considerations given below, it would in fact appear that the mean life of the intermediate nucleus cannot be longer than about 5×10^{-13} sec. in this case.

In essence, the experiments consisted in collecting the fission products from a 'thick' layer of uranium bombarded by neutrons, in thin sheets of polythene, when different thicknesses of absorbing material were interposed between the uranium and the collector and different orientations were adopted with respect to the stream of neutrons from the lithium target. (Lithium bombarded by deuterons, 100 μa. at 900 kv., was used as source of fast neutrons in these experiments.) When the active products were collected in the forwards direction with respect to the neutron beam, and aluminium was used as absorbing material, an experiment was first made to see whether the normal 'thick layer absorption curve' was obtained. This was found to be the case; the amount of activity collected on the polythene sheet appeared to vary accurately as the square of the remaining range of the particles, when a small residual effect, ascribed to ^{27}Mg and ^{24}Na recoiling from the aluminium itself, was allowed for. A single range of 3·30 mgm./cm.^{2} was deduced from these results. An absorption curve for the fission products projected in the backwards direction was then taken and compared with the first. Within the accuracy of the experiment (about 5 per cent) both the range of the particles and the total yield of the active products were the same as in the forwards direction.

A more sensitive test for asymmetry was next applied. A 'sandwich' was made of a thick layer of uranium between gold foils each 6·74 mgm./cm.^{2} thick, and the activities collected on equal polythene sheets, placed in contact with the gold on either side, were compared after the composite system had been irradiated with neutrons. The general activity was reduced to one eighth of that from an uncovered layer of uranium, and 10 ± 3 per cent more was obtained on the forwards collector than on the other. When a 'sandwich' was made with gold foils 7·13 mgm./cm.^{2} thick, 19 ± 3 per cent more activity was obtained forwards than backwards.

An asymmetry of the type observed shows that, after capture of the neutron, fission of the nucleus usually occurs before the original momentum of the system has been lost. On the existing data concerning the ranges of the heavy radioactive recoil atoms, an estimate of this time may be made. Remembering that the momentum of a 14-million electron volt neutron is roughly the same as that of the least energetic of the α-particles from the natural radio-elements, and that in the present instance the path of the compound nucleus is in solid uranium, a value of 2×10^{-13} sec. is obtained. A time of the same order of magnitude will be required even for the compound nuclei formed by the capture of neutrons of much less energy. Taking all things into consideration, therefore, 5×10^{-13} sec. seems a safe upper limit to the lifetime of these compound nuclei.

Having drawn the main conclusions from the qualitative observation that more activity is collected, through a given thickness of absorber, in the direction of neutron motion than in the reverse direction, it is interesting to try to calculate the magnitude of the asymmetry to be expected on the assumptions which have been made. If a neutron of mass m and energy E is captured into a compound nucleus of mass $2M$, and if this then breaks up with the release of energy $2Q$, in the simplest case, when the break-up is into fragments of equal mass, the relative energy difference, $\Delta Q/Q$, between forwards and backwards fragments, is $2(mE/MQ)^{\frac{1}{2}}$. With $M = 120\,m$ and $Q = 7\,E$, $\Delta Q/Q = 0{\cdot}07$. On any reasonable assumptions, the relative difference in range, $\Delta R/R$, for heavy atoms of the energy in question, will be of the same order of magnitude. This difference, of course, refers to the actual range; when an absorber is used, the relative difference in remaining range is correspondingly greater. With an absorber which reduces the activity collected from a thick layer to only 9 per cent of the total activity without absorber, theoretically a remaining range of 30 per cent of the full range is to be expected. In such a case the relative difference in remaining range between forwards and backwards fragments is about 25 per cent, with the figures quoted, and roughly 60 per cent more activity is to be expected on the 'forwards' collector than on the other. Even taking count of the smaller difference which would be contributed by fission products formed by capture of neutrons of smaller energy, a 30 or 40 per cent asymmetry should result. It is not easy to reduce this figure to the 10–20 per cent which is all that is observed. However, at this stage, the discrepancy is not important.

The experiments which have been described were made possible by the co-operation of members of the Cavendish High Voltage Laboratory, to whom I wish to express my thanks.

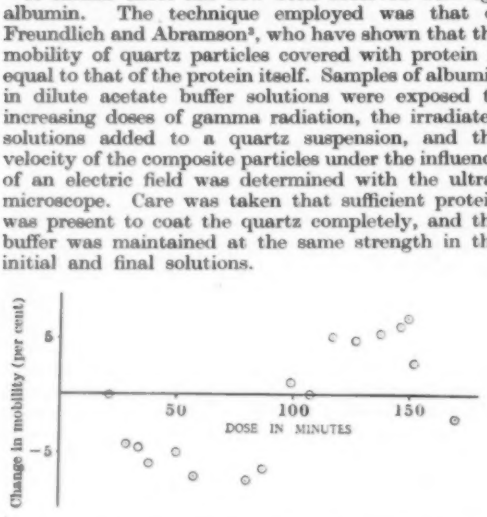
Cavendish Laboratory, Cambridge.
March 30.
N. FEATHER.

[1] NATURE, **143**, 330 (1939); *Phys. Rev.*, **55**, 418 (1939).
[2] *Phys. Rev.*, **55**, 417 (1939).

An Effect of Gamma Radiation on Egg Albumin

IT has previously been shown that the electrophoretic mobility of particles of inorganic sols and suspensions can be influenced by small doses of X- and gamma-radiation. The mobility does not vary monotonically with the dose but exhibits a series of maxima and minima[1,2].

A similar effect has now been observed with egg albumin. The technique employed was that of Freundlich and Abramson[3], who have shown that the mobility of quartz particles covered with protein is equal to that of the protein itself. Samples of albumin in dilute acetate buffer solutions were exposed to increasing doses of gamma radiation, the irradiated solutions added to a quartz suspension, and the velocity of the composite particles under the influence of an electric field was determined with the ultramicroscope. Care was taken that sufficient protein was present to coat the quartz completely, and the buffer was maintained at the same strength in the initial and final solutions.



The results of a typical series of experiments are given in the accompanying graph, in which the percentage change of mobility is plotted against the time of exposure. A significant effect can already be observed after an exposure of 30 minutes, and as in the case of the inorganic sols, the curve relating the dose with the change of mobility passes through a minimum and a maximum. The probable error of a single velocity determination was found to be 0·5 per cent. The rate of irradiation as estimated from the amount and disposition of the radium employed was rather less than 3 röntgens per minute. Experiments are in progress to determine it with greater precision.

It is interesting to note that if unirradiated protein is added to a quartz suspension and the solution is then irradiated, the mobility of the composite particles remains unchanged over the range of doses investigated.

Department of Physics, University of Reading.
March 6.
J. A. CROWTHER.
H. LIEBMANN.

[1] Crowther, J. A., and Liebmann, H., NATURE, **140**, 28 (1937).
[2] Crowther, J. A., Liebmann, H., and Jones, R., *Phil. Mag.*, **26**, 120 (1938).
[3] Freundlich, H., and Abramson, H. A., *Z. phys. Chem.*, **133**, 51 (1928).

A Positive Beam in Cathode Ray Tubes

DURING the course of work on behalf of the Radio Research Board of the Department of Scientific and Industrial Research, certain phenomena have been observed in high vacuum cathode ray tubes of a commercial type.

The electrode system of this type of tube consists of an indirectly heated cathode, surrounded by a cylindrical electrode to control the electron quantity; an accelerating anode; a focusing anode; a final gun anode; and the two pairs of deflecting plates, each being connected separately. The fluorescent screen (blue, with short delay) is at a considerably lower potential than the gun anode, so that when electrons are projected from the gun with velocities corresponding to about eleven hundred volts or less, they slow up completely before reaching the screen, reverse their direction of travel, and finally return towards the gun. Under these latter conditions, when there is no fluorescent spot on the screen due to the electron beam, a faint, slightly more greenish spot has been observed, which can be brought to a comparatively sharp focus by reducing the potential on the electron focusing anode. Furthermore, the brilliance of this spot can be controlled by the electron quantity control electrode in the same manner as the electron beam.

This new spot first appears when the gun potential is about five hundred volts positive, increasing in brilliance up to a gun potential of about eleven hundred volts, above which it becomes unstable. With a further increase of potential the electron beam also reaches the screen, but also in a very unstable condition, wandering over the screen at random. During this condition, the newly observed spot is also present, in close proximity to the electron spot. Finally, when the potential is raised to about twelve hundred and fifty volts, the electron beam becomes stable and the new spot disappears. It is found that the screen has been badly damaged in the region of the spot, and it is thought that this damage may be due to bombardment by heavy particles moving relatively slowly.

Experiments made with electrostatic and magnetic deflecting fields indicate that the new spot observed under the above conditions is caused by a beam of positive ions. It has been further noticed that there is a very considerable external negative electrostatic charge on the glass of the tube in the region of the spot. This charge is sufficient to block the grid of an amplifying valve when a lead from the grid end of its high impedance input circuit is moved into contact with the glass in the region of the spot. Experiments made with an electrometer triode also show that there is a concentration of charge on the inner wall of the cathode ray tube having a positive potential of several hundred volts. It is a significant fact, when the nature of the beam is considered, that the electron beam produces no indication on the electrometer valve.

Considering the phenomena, especially the manner in which brilliance and focus are affected by the electron beam controls, it would appear that the production of positive ions is a secondary effect from the primary electron stream, possibly due to the slowing up of the beam and the slight trace of residual gas in the tube, although the tubes in question are of the hard or high vacuum type.

To sum up, it appears that positive ions can be generated in some types of cathode ray tubes having

high vacua, and that these ions can travel towards the screen, causing bad damage with attendant loss of fluorescence. This effect should be especially noticeable in cathode ray tube systems employing mixed electrostatic and magnetic scanning, where a line will appear across the screen after some use, owing to the fact that the ion beam is not appreciably deflected by the magnetic field.

Thanks are due to the Department of Scientific and Industrial Research and the Medical Research Council for permission to publish this note.

JAN FORMAN.

Ultra-Short Wave Laboratory,
London Hospital Medical College, E.1.
Feb. 22.

Surface Structures of Possibly Atomic Dimensions using Autelectronic or 'Field' Emission from Fine Metal Points

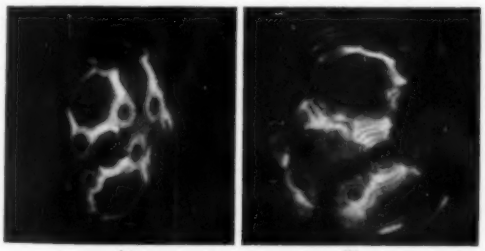
WE have set out to study the contamination of metal surfaces, using the field emission from fine points to give large-scale patterns representing the angular distribution of electron emission.

The general technique adopted is similar to that described by Müller[1,2], but we have found that with the wide-angle beams obtained a spherical bulb is desirable. The patterns which we have obtained from clean tungsten are so well defined that we feel it may be of general interest to describe the results so far obtained.

A fine tungsten point is mounted on a thick filament in the centre of a spherical bulb, one half of which is coated with fluorescent material. The anode consists of a carbon film on the other half of the bulb.

After suitable exhaust treatment, the filament is dimmed to room temperature or a little above, and a voltage of the order of 10 kv. is applied to the anode. An electron pattern of the emitting point is then obtained on the screen.

In our experiments the points have been different from those of Müller, being formed by electrolytic etching of fine wires of diameter 0·05 mm. The solid angle subtended by the pattern on the screen is considerably wider than Müller shows, and contains more pattern elements.



(*a*) (*b*)

Fig. 1.
PATTERN FROM CLEAN TUNGSTEN

In Fig. 1(*a*) is shown a photograph of a typical pattern on the screen. The symmetry of the pattern will be at once apparent, and the dark spaces can be identified, as Müller has done, as corresponding to the directions of the normals to the main lattice planes in the crystal. It is noteworthy that, except when the surface is heavily contaminated, there appears to be no luminosity in these areas.

In the case under consideration, the crystal has a cubic structure, and the centres of the large octagons correspond to the (100) planes. The small well-defined circles forming triangles are the (211) planes, and the centre of the main rectangle corresponds to the (110) plane. The fainter ones either side of the (110) are the (221) planes. The centres of the triangles corresponding to the (111) planes are not fully dark.

From the emission-voltage characteristics, the radius of the point and the size of the emitting area can be approximately estimated, using the Fowler-Nordheim formula[3,4]. For the point shown in Fig. 1 (*a*) the radius is $1{\cdot}5 \times 10^{-4}$ cm., and the emitting area is $2{\cdot}5 \times 10^{-11}$ cm.^{2}. Optical measurement indicated that the point radius was 5×10^{-5} cm.

In Fig. 1 (*b*), we show the pattern obtained with a somewhat larger point. (A rough measure of the size is given by the voltage necessary to obtain the pattern.) It will be observed that the pattern is basically the same as in Fig. 1 (*a*), but that the dark spaces are surrounded by multiple lines. The bright parts of the pattern are made up of small twinkling spots in rows forming the multiple lines, shown in Fig. 1 (*b*). From the number of spots present, and the emitting area, these spots must correspond with areas of atomic dimensions. Their agitation is quite clearly a function of temperature.

Using thoriated tungsten points, we have found that the basic tungsten pattern can be obtained. The surface can then be covered with a monatomic layer of thorium. The patterns obtained give some idea of the way the surface becomes covered.

It seems to us that the technique described offers an extremely simple method for the study of metallic surfaces and the contamination of such surfaces. For example, the arrival and removal of gas ions can be clearly observed.

We hope to publish our detailed results in the near future.

M. BENJAMIN.
R. O. JENKINS.

Research Laboratories,
General Electric Company, Ltd.,
Wembley.
Feb. 16.

[1] Müller, E. W., *Z. Phys.*, **106**, No. 9–10 (1937).
[2] Müller, E. W., *Z. Phys.*, **108**, No. 9–10 (1938).
[3] Gossling, B. S., see Nordheim, *Phys. Z.*, **30**, 189 (1929).
[4] Stein, Gossling, Fowler, *Proc. Roy. Soc.*, A, **124**, 699 (1929).

Magnetic Evidence regarding the State of Manganese in Glasses

MUCH controversy centres around the role of manganese as a colorant of glass. Mellor[1] states that manganese colours alkaline glasses pink to violet under oxidizing conditions. According to Thorpe[2], the full colour is only developed when manganese is in a fully oxidized condition (Mn^{iv}). In Fuwa's[3] opinion, the manganic oxide is responsible for the pink colour, and colourless manganese in glasses is bivalent.

Notable contributions on the subject have been made by Bancroft and Nugent[4], Solomin[5], Childs and co-workers[6], Turner and Weyl[7], Springer[8], Hoffman[9] and others. According to Sir Herbert Jackson[10], none of the evidence is conclusive. An attempt has been made by us to clarify the issues by the aid of

magnetic susceptibility measurements of the manganese glasses. Borax and phosphate glasses have been chosen to start with on account of their availability in the pure state and the simplicity of their preparation.

The melts were made in an electric furnace. The colour conditions could be determined at any time by removing a small bead on a platinum wire. The melt could be made coloured or colourless at will. It was decolorized with tartaric acid and it regained its full colour on prolonged heating in air. Manganese was estimated by the 'bismuthate method'. The magnetic measurements were made on a balance of the Gouy type.

In the case of the decolorized samples, the experimental value of χ was found to be $268{\cdot}3 \times 10^{-6}$. This compares well with the theoretical value $269{\cdot}3 \times 10^{-6}$ for divalent manganese, showing that manganese in the decolorized product is in the divalent state.

It was found that in the case of the coloured samples the susceptibility for manganese ion had a value intermediate between those required for divalent and trivalent manganese on the well-known Stoner and Van Vleck formula.

On exposure to ultra-violet light from a quartz mercury vapour lamp with a Wood filter, it was found that the decolorized glass gave an orange-red fluorescence resembling that obtained in the case of the anhydrous manganese halides, thereby lending further support to the view that manganese is divalent in this case[11]. The coloured sample did not exhibit this type of fluorescence.

Phosphate glass prepared from microcosmic salt was also similarly treated. The coloured product was non-fluorescent while the decolorized sample fluoresced with an orange-red glow, indicating divalency of manganese in the reduced glass. The phosphate glasses are being examined by the magnetic method, and the preliminary results indicate complications arising from the probable polymerization of the manganese salts formed.

It is interesting to recall here that the name pyrolusite has been derived from πῦρ, fire, and λύω, I wash, owing to the use of this material by the ancients for the removal of colour from glass tinged by iron.

The controversial mechanism of this change is amenable to a satisfactory treatment by the methods described above. Full details of these studies will be communicated shortly in papers to be published jointly with Messrs. Brahm Prakash, B. D. Khosla and Abdul Hamid.

S. S. BHATNAGAR.

University Chemical Laboratories,
University of the Panjab,
Lahore.

[1] Mellor, "A Comprehensive Treatise on Inorganic and Theoretical Chemistry", 6, 523 (1935).
[2] Thorpe, "Dictionary of Applied Chemistry", 2, 721 (1912); 3, 386 (1922).
[3] Fuwa, *J. Japan Ceramic Assoc.*, 366, 80–97 (1923).
[4] Bancroft and Nugent, *J. Phys. Chem.*, 33, 481 (1929).
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[6] Childs and co-workers, *J. Soc. Glass Tech.*, 15, 172–81 (1931).
[7] Turner, W. E. S., and Weyl, W., *J. Soc. Glass Tech.*, 19, 208–16 (1935).
[8] Springer, L., *Glashutte*, 61, 611 (1931); *J. Soc. Glass Tech.*, 15, 386A (1931); "Ceram. verrerie. emaillerie", 251–3 (1933).
[9] Hoffman, J., *Glass*, 13, 419–20, 423, 433 (1936).
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Jahn-Teller Theorem and the Arrangement of Water Molecules around Paramagnetic Ions in Aqueous Solutions

IT is well known from X-ray studies that in many of the highly hydrated salts of the iron and the rare earth groups the cation is surrounded by an octahedron of water molecules. This distribution fits well with the observed magnetic properties of these salts; first, it gives an electric field of predominantly cubic symmetry about the central cation, as required by the magnetic data, and secondly, it gives the potential of the electric field the proper sign demanded by the magnetic data. The magnetic data, however, further require (1) that the field, though predominantly cubic in symmetry, should deviate from it considerably, since the cation in these crystals exhibits, in general, a strong magnetic anisotropy, and (2) that for a given cation the magnitude and the asymmetry of the electric field about it should be nearly the same in the different hydrated salts containing the ion, since the magnetic anisotropy of the ion is found to be of the same order of magnitude in all these salts. These requirements will be satisfied in a simple manner if the octahedron, instead of being regular, deviates from it slightly—a small deviation is permitted by the available X-ray data—and the deviation is determined by the nature of the cation in the centre. This arrangement appears very probable in view of the important theoretical result obtained recently by Jahn and Teller[1], namely, that if the electronic state of the central ion is degenerate, the system will be stable only if there is enough asymmetry in the system to remove the degeneracy (except, of course, the special two-fold degeneracy of Kramers). This minimum asymmetry required for stability supplies then the mechanism by which the cation can in a manner determine the geometry of distribution of the water molecules around it.

Such an asymmetric arrangement of the water molecules about the cation seems to persist even in the aqueous solutions of these salts. Freed and his collaborators[2] have found in the observed multiplicity of the absorption lines of the rare earth ions in aqueous solutions evidence for asymmetric electric fields, nearly the same as in the corresponding hydrated crystals. A comparison of the magnetic behaviour of some of the paramagnetic ions, both of the rare earth and the iron groups, in aqueous solutions, with the ideal free-ion behaviour on one side, and with the behaviour of the ions in the hydrated crystals on the other, also leads to the same conclusion.

The large magnetic double-refraction exhibited by aqueous solutions of these salts[3] follows as a natural result. Owing to the asymmetry in the distribution of the water molecules about the paramagnetic ion, and the consequent asymmetry of the electric field about the ion, the group as a whole will be magnetically anisotropic, and will tend to orient in the magnetic field. Since the group will also be optically anisotropic, the solution will exhibit double-refraction. Now these anisotropies, according to the views presented here, should depend indirectly on the incipient degeneracy of the electronic state of the central paramagnetic ion, and in particular on the orbital degeneracy. The observation by Chinchalkar[4] that the double refraction depends on the orbital angular momentum of the paramagnetic ion, and that in particular the double refraction is almost

nothing when the ion is in the S-state, (for example, Gd^{+++}) is significant. Indeed, from the known magnetic anisotropy of the group in the crystal state, and its birefringence, a rough estimate can be made of the magnetic double refraction of the solution, and it is found to be of the right order of magnitude.

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Feb. 15.

[1] *Proc. Roy. Soc.*, A, **161**, 220 (1937); **164**, 117 (1938).
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A Comprehensive Fundamental Electrical Formula

DR. C. V. DRYSDALE has pointed out that his formula[1] can be applied to the calculation of what are usually called 'electromagnetic forces'; and it then becomes an expression (in vector notation) for the generally accepted principle called the Biot-Savart law. But the experiments to which I referred in NATURE of August 7, 1937, have shown that the Biot-Savart law sometimes indicates only a small fraction of the actual force, and have therefore shown the serious incorrectness of the more general formula proposed by Dr. Drysdale.

The accuracy of my experimental results was verified by finding that they were all in close agreement with the formula given in Maxwell's Art. 583. When applied to the case shown in Fig. 2 of my above-mentioned communication to NATURE, this formula becomes

$$F = \tfrac{1}{2}i^2 dL/dy,$$

where F is the force that acts in the vertically downward direction on $MBCN$, while this part of the circuit moves through the distance dy in that direction, which movement increases the inductance by the amount dL. The value of dL/dy can be found by differentiating the well-known expression for the inductance of a rectangular circuit. Maxwell's formula says that the vertical force exerted on $MBCN$ by $MADN$ and on $MADN$ by $MBCN$, is $8{\cdot}74\,i^2$, whereas Drysdale's formula says that the force exerted on $MBCN$ by $MADN$ is $0{\cdot}43\,i^2$, and that the force exerted on $MADN$ by $MBCN$ is $0{\cdot}17\,i^2$, this last being less than one-fiftieth of the actual force. Here it will be seen that Drysdale's formula contradicts, to a very serious extent, both Maxwell's formula and Newton's laws of motion.

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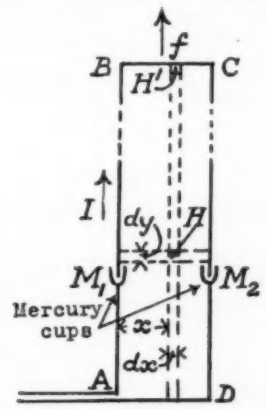
[1] NATURE, **142**, 995 (1938).

MR. DUNTON'S measurements do not in any way affect the validity either of my equation, the Biot-Savart law, Faraday's law of electromagnetic induction, or the magnetic flux-cutting equation. His error lies in assuming that it is only the magnetic field of the lower fixed portion M_1ADM_2 of the accompanying circuit which produces a force on the conductor BC; whereas the only part of the magnetic field produced by the whole circuit which does not produce a force on BC is that due to BC itself. If for simplicity we consider a very long narrow rectangular loop of breadth b and conductor radius a, the magnetic



force at any distance x from AB and remote from BC or AD is $H = 2I/x + 2I/(b-x)$, and hence if the length of the loop is increased by the amount dy

$$\frac{\partial L}{\partial y} = 2\int_a^b \{1/x + 1/(b-x)\}dx,$$

neglecting the internal magnetic field in the conductors. But the magnetic force at a corresponding point on BC is $H' = H/2$, and the force on BC or on AD is therefore

$$f = I\int_a^b H'dx = I^2\int_a^b \{1/x + 1/(b-x)\}dx = \tfrac{1}{2}I^2\frac{\partial L}{\partial y},$$

which is Maxwell's formula, with which Mr. Dunton's measurements agreed. He ought actually to have observed a somewhat greater force due to the pressure on the ends of the conductors caused by the constricting effect of the current in the mercury (the 'pinch phenomenon' of Carl Hering), which is covered by the same argument; but the above is sufficient to show that his supposed discrepancy has no foundation.

C. V. DRYSDALE.

Frequency Interpretations in Probability

IF he were consistent, de Moivre would *not* have accepted 5/12 as the probability in Dr. Jeffrey's problem. (Two boxes, one containing 1 white and 2 black balls, the other 1 white and 1 black. Choose a box; then draw a ball; what is the probability of drawing white? NATURE, Feb. 11.) For, according to his definition, the statement that the probability is 5/12 must mean that there are $12n$ different possible cases, of which $5n$ are favourable, n being an integer. That simply is not true.

The 'modern' who affirms 5/12 must hold that probability means something other than the ratio of favourable to possible cases. When the cases are sums of "equally possible" elements, then the probability happens to be that ratio, but not otherwise. De Moivre's definition, or Laplace's modification of it, is not wrong; it is merely unduly limited; it tells us nothing about probability except in a limited class of problems.

The question is then what is the general meaning of probability, and why, in this limited class, does it happen to be measured by the ratio? The question can be answered in accordance either with Dr. Deming's view or Dr. Jeffrey's. My object is not to answer the question, but to point out that an answer is required.

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Use of the Termination *-tron* in Physics

IN the invention of names in physics, there appear to be two schools of philological thought as to the meaning of the termination *-tron*. According to one school, it is derived from a Greek word signifying an instrument, as illustrated by *cyclotron* or *thyratron*, whereas according to the other it signifies an elementary particle, as in *positron* and now *mesotron*. The decision as to which is the better meaning is in no way helped by reference to authority, for the ancients appear to have been wholly ignorant of the use of the word in either sense, or indeed in any sense at all. It is perhaps none the worse for that, but it does seem an unnecessary confusion to introduce, out of all possible combinations of letters, exactly the same four to represent a new machine or a new particle. If the termination is to be accepted for both, it is indeed rather hard to think of anything in modern physics to which it might not be applied.

Discoverers are of course free to name their inventions as they please, but there would be, to say the least, a convenience if the chosen name terminated with something expressing the category to which its possessor belongs, so that *-tron* should be restricted to signify either an instrument or a particle, but not both. The names *thyratron* and *cyclotron* have already got into wide use, so that it would seem almost impossible to change them without confusion. On the other hand, *positron* and *mesotron* are household words in the mouths of comparatively few, and to rename them would not cause such widespread trouble. The situation is unavoidably complicated of course by the *electron* and *neutron*, but the division of these as *elec-tron* and *neu-tron* is one which the most illiterate would scarcely make, and *-on* taken by itself—why not for example *poson* and *negon*?—seems the most natural ending for a particle.

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Growth-controlling Hormonal Substances of the Hypophysis

STUDYING the substances which accelerate or inhibit the growth of plants, and which are present in different extracts of particular organs of animal body, we have found that the acetonic extract of the anterior lobe of the hypophysis accelerates the growth of plants, while the same extract of the posterior lobe of the hypophysis inhibits their growth.

Later, we experimented with various extracts of organs influencing the growth of animals. These experiments were performed upon young animals of the same breed (rabbits, guinea pigs), and especially upon young rats of about 30 gm. in weight. We have found in the acetonic extract of the anterior lobe of hypophysis a substance which accelerates the growth of normal young animals compared with controls under the same conditions. This substance is not identical with the somatotropic hormone of Evans because its physical and chemical properties (freedom from albumin, resistance to boiling, reduced sensibility to alkali, etc.) are different. Compared with the controls of the same breed, the normal size of the animals under treatment is attained under the influence of the substance in a shorter time. The action was evident after two or three injections of the extract.

The acetonic extract of the posterior lobe of hypophysis was found to have an opposite result. After two or three subcutaneous injections of the extract, the growth of the animals became so much inhibited that two or three months later the weight of the treated animals was only slightly increased compared with controls. The treated animals presented quite a normal appearance not only in their behaviour but also in their appetite. The anatomical examination of the animals which were killed has shown no pathological changes in the organs, which were of an inferior average weight compared with the organs of the controls.

There exist, therefore, in the hypophysis not only the somatotropic growth hormone discovered by Evans, but also other growth-controlling substances, namely, in the anterior lobe a growth-stimulating, and in the posterior lobe a growth-inhibiting substance. We suggest that the substance inhibiting the growth of animals and of plants in the posterior lobe of the hypophysis be named 'amicine'.

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Pearson Foundation.

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Pentose Nucleotides in the Cytoplasm of Growing Tissues

INTEREST in the nucleic acid metabolism of mitosis has in general tended to centre on the nucleus. More recently evidence has been obtained showing an interplay between the nucleic acid metabolism of the nucleus and that of the cytoplasm[1]. Studying the ultra-violet absorption spectra of the cytoplasms of growing tissues, we have found them all to exhibit the maximum around 2600 A., characteristic of the cyclic nitrogenous bases present in the nucleic acids. In contrast, the homologous mature tissues exhibit a different absorption similar to that of the proteins.

The cells from rapidly growing yeast cultures have already[2] been shown to differ from the cells of the senescent cultures in containing a much higher concentration of the substances absorbing maximally at 2600 A. An estimate of the total absorbing substances, calculated as yeast nucleic acid, agrees well in order of magnitude with Baumann's data[3] for the yield on the extraction of yeast nucleic acid from yeast.

In the tissues of the plant embryo, prepared as they are for rapid growth and division, it has long been known that yeast nucleic acid was present[4,5]. The absorption spectrum of cells from the rye embryo shows a maximum at 2600 A., with an additional absorption indicating a high concentration of proteins. Here Behrens[6] has shown that yeast nucleic acid can be extracted from the cytoplasm of the cell itself.

In the eggs and embryos of animals, pentose nucleic acids have already been demonstrated for the sea urchin[7], chick[8] and fish[9]. The absorption spectrum of the *Drosophila* egg cytoplasm agrees well with that of a nucleic acid[1]. Moreover, the imaginal disks of the *Drosophila* larva, which are dividing rapidly while the larval cells merely increase in size, have a strongly absorbing cytoplasm the absorption spectrum of which has a maximum at 2600 A. In the mid-gut of the larva, where the imaginal cells are present in small nests among the larval cells, it is easy to compare the absorption spectra of the two types (Fig. 1). The functional gut cell of the larva has a much lower concentration of absorbing materials, and the shape of the absorption curve is more like that of proteins.

The system of apical growth in the root of plants is another case in point. We have studied the *Allium* root-tip, finding in the zone where mitoses are occurring, cells with a high concentration of absorbing materials the absorption spectrum of which is of the nucleic acid type. Towards the base the cells which will no longer divide have the absorption spectrum of a protein with cyclic amino acids (Fig. 2).

The absorbing substances are probably pentose nucleotides. In the cases of yeast and the rye embryo, yeast nucleic acid has been extracted. In the *Drosophila* and the *Allium* material a strong orcin reaction for pentoses has been obtained in the same tissues, which on micro-incineration show a plentiful residue of ashes that give a positive test for phosphorus. That the pentose, phosphorus and ultra-violet absorbing substances mentioned above occur in the same tissues gives support for the assumption of the presence of nucleotides.

It seems likely that a high concentration of nucleic acids is the basis of the generally noted basophily of embryonic tissues. Those here discussed are strongly basophilic, in correlation with the high ultra-violet absorption. The presence of pentose nucleotides in high concentrations in rapidly dividing tissues is probably thus a general phenomenon.

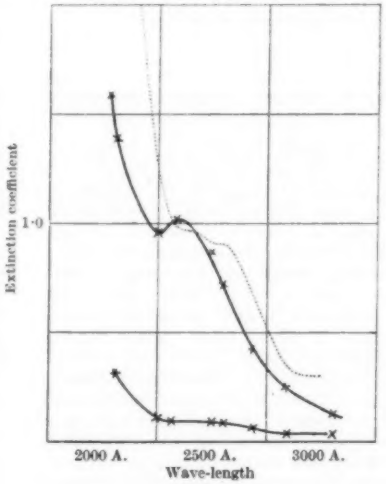

Fig. 1.

A COMPARISON OF THE ULTRA-VIOLET ABSORPTION SPECTRUM OF THE MATURE LARVAL GUT CELL (LOWER CURVE) WITH THAT OF A CELL FROM THE IMAGINAL DISKS OF THE MIDGUT (UPPER CONTINUOUS CURVE). IN THE DOTTED CURVE THE VALUES OF THE LOWER CURVE ARE MULTIPLIED BY THE FACTOR 10 TO PERMIT A COMPARISON OF SHAPES.

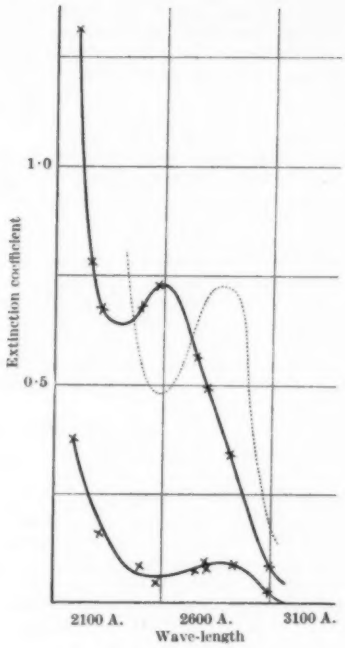

Fig. 2.

THE ULTRA-VIOLET ABSORPTION SPECTRA OF THE CYTOPLASM OF A CELL FROM THE GROWTH ZONE (UPPER CURVE) AND FROM THE BASE (LOWER CURVE). THE DOTTED CURVE HAS THE SAME MEANING AS IN FIG. 1, BUT THE VALUES OF THE LOWER CURVE ARE MULTIPLIED BY 8 IN THIS CASE.

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The Enzyme System Transferring the Amino-Group of Aspartic Acid

I HAVE, in recent communications[1,2], described a method for the preparation of a purified enzyme from muscle tissue, catalysing the reversible transfer of amino nitrogen from glutamic acid to monocarboxylic α-ketoacids[3]. The enzyme preparation is inactive with regard to the *Umaminierung*, or 'trans-amination' of aspartic acid, whereas this process is readily effected

by the original muscle pulp[4]. I have since been successful in obtaining from muscle tissue, by means of a modified purification scheme to be described in detail elsewhere, enzyme preparations catalysing the transamination of aspartic acid at a considerable rate in the presence of a thermostable activator, or coenzyme, contained in tissue extracts.

This enzyme preparation still contains the enzyme of glutamic acid trans-amination, but from vegetable materials preparations can be obtained that are active only with regard to aspartic acid while completely indifferent to glutamic acid. The aspartic enzyme differs from the glutamic enzyme in that it is more readily extracted from tissues by aqueous solvents, and also in its higher lability. The glutamic enzyme appears to contain an active group similar to the coenzyme of aspartic enzyme, but less readily dissociable. The chemical nature of the active thermostable constituent is under investigation in this laboratory.

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[1] Kritzmann, *Biochimia* (Moscow), **3**, 693 (1938).
[2] *C.R. Acad. Sci. U.R.S.S.*, **21**, No. 1–2, 72 (1938).
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Purification of Uricase

URICASE is an enzyme which catalyses the oxidation of uric acid. It was reported recently by Davidson[1] that he had been able to obtain a preparation of uricase about a thousand times more active than the acetone powder of liver which was used as a starting material. Several purified preparations showed, according to him, a high and fairly constant iron content ranging from 0·15 to 0·20 per cent, which he regards as evidence in favour of the view that iron is a constituent of uricase.

Using a modified method of purification, I have been able to obtain preparations 1,000–1,400 times more active than the acetone powder of pig's liver used as initial material. My preparations are completely colourless, insoluble in water and only sparingly soluble in alkaline buffer solutions. The iron content of these preparations as determined on samples up to 16 mgm. of dry weight, is only 0·02 per cent.

Their catalytic activity is poisoned reversibly by potassium cyanide but not by hydrogen sulphide, αα-dipyridyl, pyrophosphate or diethyldithiocarbamate.

The lack of proportionality between iron content and activity in preparations obtained with different methods and the very low iron content (0·02 per cent) in highly purified enzyme preparations make it very improbable that iron is a constituent of uricase.

An account of the purification and properties of the purified enzyme will be given elsewhere.

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March 3.

[1] Davidson, J. N., NATURE, **141**, 790 (1938). *Biochem. J.*, **32**, 1386 (1938).

Marrubiin, a Diterpenoid Lactone

ACCORDING to Gordin[1], marrubiin, the optically active bitter principle of *Marrubium vulgare*, is a lactone, $C_{21}H_{28}O_5$, m.p. 154·5°–155·5°, which on hydrolysis yields marrubic acid, $C_{21}H_{30}O_5$, m.p. 173°–174°, forming an ethyl ester, m.p. 87°.

In the course of an investigation on the constitution of this compound, which has m.p. 158°, we have found that the analytical results and molecular weight determinations given by marrubiin and a number of its derivatives are in agreement with the formula $C_{20}H_{28}O_4$ for the lactone which on hydrolysis gives rise to a monobasic acid $C_{20}H_{30}O_5$, m.p. 197° (methyl ester, m.p. 85°; ethyl ester, m.p. 88°). Hydrogenation of marrubiin and marrubic acid gave the corresponding tetrahydro-derivatives, m.p. 132° and m.p. 187° (ethyl ester, m.p. 95°) respectively, which like the parent compounds are interconvertible.

Determination of active hydrogen indicates that marrubiin contains one hydroxyl group and, since the compound does not appear to form acyl derivatives under the usual conditions, this is in all probability a tertiary alcoholic group; the fourth oxygen atom is present in an oxide system. Marrubiin, which is readily resinified by warm mineral acids and by hot formic acid, gives rise on oxidation with potassium permanganate to a neutral compound, m.p. 211°, and a lactone, m.p. 161° (acid, m.p. 208°), which is also formed along with a liquid acid by the action of ozone, whilst dehydrogenation with selenium furnishes a comparatively good yield of 1 : 2 : 5-trimethylnaphthalene (agathaline). It is concluded that marrubiin is a hydroxyditerpene lactone of the manoyl oxide type.

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[1] Gordin, *J. Amer. Chem. Soc.*, **30**, 265 (1908).

Effect on Bacteria of Continued Cultivation in Lecithin Broth

THE pathogenic properties of bacteria (typhi, dysenteriæ, coli) are slowly reduced by daily subcultures (about a hundred) on bouillon containing between 0·2 per cent and 4 per cent colloidal lecithin[1]. For the sake of brevity these will be designated as *L*-bacteria and normal organisms as *N*-bacteria.

Particularly interesting results were obtained with *B. typhi murium*, which after four hundred subcultures required 10,000 times the original dosage to produce a fatal effect when injected intraperitoneally into mice (1,000 and 10,000,000 living bacteria, respectively). Neither fifty subsequent subcultures on ordinary media nor twelve animal passages induced a return of the pathogenic properties. The agglutinability of the *L*-bacteria with immune serum produced by the corresponding *N*-bacteria was not measurably lessened, nor was their ability to produce H and O agglutinins in affected animals.

The duration and intensity of the immunity resulting from intraperitoneal administration of *L*-strains were equal to the results observed in surviving animals infected with *N*-strains, and the results were better than those obtained by the injection of 10-100 times as many *N*-bacteria killed at 60° C.

Groups of pregnant mice which received ten oral doses (0·5 c.c. daily) of a 24-hour living broth culture of an *L*-strain of *B. typhi murium* gave birth as normally as untreated controls. A similar group of mice treated at the same time with equal numbers of *N*-bacteria showed 100 per cent mortality.

Three months later, the mice which had been fed *L*-strains were given orally large numbers of *N*-bacteria: the resulting mortality was 15 per cent, whereas controls which had been immunized at the same time with large numbers of heat-killed *N*-bacteria showed a mortality of 80 per cent.

A certain degree of attenuation in virulence was also noticed after passage of *N*-bacteria on ordinary media. After four hundred passages of *B. typhi murium*, the lethal dose was fifty times that of the initial culture. However, in most such cases a few animal passages sufficed to bring the pathogenicity of the strain back to its original degree.

In animals inoculated with *L*-strains the bacteria disappeared from the blood stream and organs within a few weeks and sometimes within as short a time as 48 hours. Animals which had recovered from sub-lethal doses of *N*-strains generally remained carriers for many months.

All the *L*-strains also showed a diminished production of endotoxins. This effect is irreversible in the case of *B. typhi murium*, even after fifty passages on ordinary media; other members of the typhi-coli-dysenteriæ group, however, recovered their endotoxicity.

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[1] *C.R.*, **206**, 1261 (1937).

Points from Foregoing Letters

FROM an observed asymmetry in the spatial distribution of the explosion fragments from uranium bombarded by fast neutrons, N. Feather concludes that less than 5×10^{-19} sec. must elapse between the capture of a neutron by the nucleus and the break-up of the system into two heavy fragments. Previously, more direct methods of investigation had indicated that this time must be less than 0·003 sec.

J. A. Crowther and H. Liebmann show that the electrophoretic mobility of egg albumin alternately decreases and increases when exposed to increasing doses of gamma-radiation.

The occurrence in certain circumstances of a beam of positive ions in high vacuum cathode ray tubes of a commercial type is described by J. Forman. It appears to be a secondary effect due to residual gas and causes damage to the fluorescent screen.

Patterns of the emission from fine metal points under autelectronic conditions can be identified, according to M. Benjamin and R. O. Jenkins, as corresponding to the main planes in the crystal lattice. The patterns obtained are made up of twinkling spots which are of possibly atomic dimensions. The technique described lends itself to the study of surface structure and surface contamination.

S. S. Bhatnagar finds that in borax glasses of manganese, the manganese ions in the decolorized variety have an experimental value of magnetic susceptibility equal to $268{\cdot}3 \times 10^{-6}$, which compares well with the theoretical value of $269{\cdot}3 \times 10^{-6}$ for divalent manganese. The coloured variety shows a value intermediate between the divalent and trivalent manganese.

On the basis of magnetic and other evidence, K. S. Krishnan concludes that the octahedra of water molecules surrounding the cation in many of the salts of the iron and the rare earth groups, are asymmetric, the degree of asymmetry being determined by the electronic state of the cation in the centre; this arrangement persists in water solutions.

W. F. Dunton argues that the "comprehensive fundamental electrical formula" proposed by C. V. Drysdale, when applied to the calculation of electromagnetic forces, will sometimes give results that are inconsistent with Newton's laws of motion, and are very different from the results given by Maxwell's energy method of calculation. In reply, Drysdale points out that the force on a straight conductor depends upon the magnetic field induced by the whole of the remainder of the circuit, and that the proper application of the flux-cutting principle or of the Biot-Savart law gives the same value for the force as that given by the Maxwellian formula.

B. Lustig and H. K. Wachtel state that they have extracted with acetone a growth-stimulating hormone from the anterior lobe of the hypophysis and a growth-inhibiting hormone from the posterior lobe.

Measuring the ultra-violet absorption spectra of the cytoplasm in cells of the rye embryo, the *Allium* root-tip and the *Drosophila* imaginal disks, T. Caspersson and J. Schultz find the absorption band characteristic of the cyclic nitrogenous bases in the nucleic acids. These ultra-violet absorbing substances are present as pentose nucleotides in high concentrations in rapidly dividing tissues.

The enzyme effecting the reversible transfer of amino nitrogen from aspartic acid to different α-ketoacids has been prepared from animal and vegetable tissues by M. G. Kritzmann. The enzyme is associated with a thermostable co-enzyme.

C. G. Holmberg states that the very low iron content (0·02 per cent) in highly purified preparations of uricase makes it improbable that iron is a constituent of this enzyme.

Marrubiin, which is the bitter principle of *Marrubium vulgare*, is an unsaturated lactone of the diterpene series, according to A. Robertson and his co-workers, having the empirical formula $C_{19}H_{28}O_4$ and containing a tertiary hydroxyl group and an oxide linking. A number of derivatives have been obtained, including agathaline, which is formed by dehydrogenation with selenium.

B. S. Levin and L. Olitzki find that bacteria of the typhi-coli-dysenteriæ group, which had been subjected to daily passages in lecithin bouillon, showed a markedly lower pathogenicity than controls grown in ordinary bouillon.

Research Items

Mangarevan Ethnology

TE RANGI HIROA (Dr. Peter H. Buck) has recently reported on the results of his ethnological observations on the Mangarevan expedition organized by the Museum in 1934, when he spent seventy days on Mangareva (*Bull.* 157, Bernice P. Bishop Museum, Honolulu). The Mangareva (Gambier) Islands lie in latitude 20° 20′ S. and longitude 134° 45′ W., 900 miles from Tahiti, and 1,450 miles from Easter Island, the eastern extremity of Polynesia. The group consists of four islands, which are the unsubmerged peaks of extinct volcanoes, without permanent streams and with only a few springs. The population is much mixed, and only a few families of full-blooded Mangarevans remain. It is probable that at no time did the population exceed more than a few thousand. It was kept within food-producing capacity by emigrations resulting from inter-group struggles for cultivable land and cannibalism. Their speech is a dialect of Polynesian, resembling that of Cook Islands, Tuamotu, and New Zealand. The culture of Mangareva is fundamentally based on the early culture that prevailed in the Society Islands before dispersion took place to Hawaii in the north and New Zealand in the south. The earliest settlers evidently drifted in from the Tuamotus in small groups, bringing no cultivable food plants, and in insufficient numbers to establish an organized system of social classes. They were a simple fisher folk. Later immigrations about A.D. 1300, in the form of organized expeditions, brought food plants from some volcanic group such as the Marquesas, or the Society Islands. They introduced the worship of Tu, the marae, and a highly organized social system. The major gods of the Society Islands are present, and the form of worship and temple follow those of Central Polynesia. The pattern of social organization is orthodox Polynesian, while the material culture has an early Polynesian pattern. Mangarevan culture was thus an offshoot of Central Polynesian culture, which reached the islands by way of the Marquesas.

Propagation of Vaccinia in Chick Embryos

METHODS of cultivating viruses on the embryonic membranes of the developing chick within its egg-shell, which have been devised during the last few years, have been applied to the cultivation of the vaccinia virus, and Lieut.-Colonel W. D. H. Stevenson and Dr. G. G. Butler have recently reported upon their extensive studies of this subject (*Ministry of Health : Reps. on Pub. Health and Med. Subjects*, No. 87. London : H.M. Stationery Office. 4*s.* net). Glycerinated calf lymph, which is usually employed for vaccination, is prepared by inoculating the skin of calves, collecting the vaccinal material and mixing it, after grinding, with glycerin, water and a small amount of preservative. However carefully prepared, the material contains numbers of extraneous micro-organisms, which are reduced by treatment and storage to a number considered safe. The vaccinia grows well in the egg, and the material so obtained can be used for vaccination. Fertile hens' eggs are used ; these are inoculated by a special technique, the eggs are opened on the fourth day of incubation, and the material is then collected. By adopting certain precautions, it is possible to obtain a lymph free from the extraneous micro-organisms which are so troublesome in ordinary calf lymph. It is suggested that in the future chick membrane lymph may replace calf lymph. Full details of the technique are given in this report, which also contains a critical discussion of the whole subject.

Acetylcholine Formation in Tissues

B. B. DICKSHIT (*Quart. J. Exp. Physiol.*, 28, 243 ; 1938) studied the formation of acetylcholine in the different tissues of dogs by suspending the tissues in warm eserinized Locke's solution and oxygenating for five hours. The brain cortex, basal ganglia, spinal cord, sympathetic ganglia, auricle, urinary bladder, gastro-intestinal tract and pancreas were found to possess the property of forming acetylcholine. Although all parts of the gastro-intestinal tract could form acetylcholine, the largest quantities were formed by the small intestine in which the nerve plexuses are chiefly responsible. The writers suggest that acetylcholine formation is a specialized function of the nerve cells.

Birds of Nanking

IN the difficulties which beset China at present it is surprising and gratifying to find that publication of scientific papers seems to continue without break. An account of the passerine birds of Nanking and its vicinity has appeared as one of the contributions from the Biological Laboratory of the Science Society of China (Zool. Series, **12**, No. 9, Shanghai, 1938). It is a guide to a passerine avifauna of 112 species and subspecies, amongst which the finches (with 22 forms) predominate, and the wrens, goldcrests and orioles are each represented by only one species. Analytical keys to the characters of families, species and subspecies, as well as many illustrations of distinctive head-markings, aid in identification. The author, L. T. Chong, has compiled the list from collections which have been accumulating in the museum of the Biological Laboratory since 1925, so that it is possible that additions may still have to be made ; but to a Western reader it is remarkable that where so many Western species of birds are represented, there should be such a dearth of subspecies familiar in Great Britain.

Tomato 'Rogues'

GROWERS of tomatoes are often troubled by the appearance of abnormal plants or 'rogues', which are of dwarf habit, have extensive lateral shoot development, with unusual leaf shape, and give low yield. M. B. Crane, of the John Innes Horticultural Institute, has investigated the genetics of these aberrant tomatoes (*Gard. Chron.*, Feb. 11 and 18, 1939). Grafting experiments have shown that the rogue condition is not pathological, and it is probable that unstable genes, which could either determine normal, or mutate to form rogues, are present in the plants concerned. Rogue plants frequently develop normal growth, and it has been found that seeds harvested from trusses at various heights on such a plant, yield varying proportions of rogues. The more general question as to any effect of position of the truss

upon normal genes has been investigated by experiments on a cross between the varieties Kondine Red and Blaby. No differing proportions of characters in the offspring could, however, be associated with varying positions of the trusses in these normal conditions. The control of rogues would appear to be easy, if sufficient care be taken to eliminate abnormal plants during the first potting, and to save seed only from tomato plants which are fully normal.

Mosaic Disease of Cassava

A VIRUS disease which causes a mosaic-like mottling of the leaves of cassava (*Manihot utilissima*) has been known in East Africa since 1894, and there has been an increasing recognition of the serious nature of the disease. H. H. Storey and R. F. W. Nichols, of the East African Agricultural Research Station, Amani, have recently made detailed studies of the malady and its transmission (*Ann. App. Biol.*, **24**, No. 4, 790-806; Nov. 1938). Symptoms exhibit wide variation, owing to varietal reactions of the host, and also to differences in strains of the virus. Two groups of strains have been recorded, one giving mild, and the other severe, symptoms. Cassava mosaic has not been transmitted to a healthy plant by mechanical means; but it can pass across a graft union, and has an insect vector, a species of *Bemisia*. The latter can only inoculate a plant through an immature leaf, a fact which should be useful in experiments upon movement of the virus. It has been found already that the virus does not pass out of the inoculated leaf until after eight days. It then moves quickly to the base of the stem, and slowly into the side branches. The presence of a mild strain of the virus does not confer any resistance against the more severe kind.

The Centromere

C. D. DARLINGTON (*J. Genetics*, **37**, 341; 1939) finds in *Fritillaria kamschatkensis* that chromosomes lag on the first metaphase plate of meiosis due to failure of bivalent formation, and more frequently as the result of bivalents being crowded off the plate. In about 1,000 first anaphases, 109 lagging chromosomes were found. Of these laggards, 107 showed transverse divisions of the centromere. It is suggested that chromosomes with terminal attachments, chromosomes with similar ends as in the extra chromosome of secondary trisomics and attached *X*-chromosomes of *Drosophila* may result from this type of division of the centromere. The structure of the centromere is discussed.

Effect of Colchicine on Allium

A. LEVAN (*Hereditas*, **24**, 471; 1938: **25**, 9; 1939) has studied cytologically the effect of colchicine on mitosis and meiosis in *Allium*. In both types of cell-division the spindle apparatus is more or less put out of action. In mitosis the normal division at the attachment constrictions is considerably delayed. Consequently the two daughter chromosomes are held together, to be included in one nucleus. In meiosis, a similar delay of division occurs, chiasma formation and contraction are reduced, leading to an increased number of chromosomes in the daughter nuclei. In two further papers, by Levan (*Hereditas*, **25**, 109; 1939), and J. Rasmusson and A. Levan (*Hereditas*, **25**, 97; 1939), the practical aspects of colchicine treatment are pointed out. The proportion of tetraploid shoots from a treated diploid plant depends on the comparative viability of diploid and tetraploid cells. Tetraploid shoots are much commoner in *Petunia* than in sugar beet for this reason.

Paper from Australian Timbers

A SHORT time ago, an arrangement was made by which the Division of Forest Products in Australia commenced to work in co-operation with the paper industry. The Division of Forest Products is under the Council for Scientific and Industrial Research, and the latter has just issued Pamphlet No. 86 under the title "A Study of the Pulping Properties of three Trees of *Eucalyptus sieberiana*, using the Sulphate Process". This species was selected because of its potential importance at the time the work was planned. The report was prepared by J. C. Cavanagh, H. E. Dadswell, A. W. Mackney, and Miss T. M. Reynolds, and acknowledgments are made to Australian Paper Manufacturers, Ltd., for their financial assistance during the period when the work was being done and prior to the association of other companies with the Division. Thanks are, it is said, also due to the company for the active assistance of its officers in carrying out the evaluations, etc., and also in discussing the problems as they arose. Three trees of *E. sieberiana* (silver-top ash), which is found in favourable quantity and size in the southern coastal districts of New South Wales, were investigated. The object of the work was to study the variability in the yield and the quality of the pulp that could be expected from different parts of one tree and from different trees. Samples of the 'truewood' and the 'heart' of the butt, centre, and top sections of the merchantable bole were accordingly tested. In general, it was found that satisfactory pulps could be obtained from all these samples. The investigation is said to have yielded valuable data, considering the small number of trees handled.

Densities of D_2O—H_2O Mixtures

LONGSWORTH, in 1937, found that at 25° mixtures of D_2O and H_2O are ideal from the point of view of volume changes on mixing. Since the publication of his paper, the density of pure heavy water has been found by Tronstad and Brun to be $d_{25}^{25} = 1{\cdot}10750$ instead of 1·10790 found by Selwood, Taylor, Hipple and Bleakney and used by Longsworth. More recently, Tronstad has given the value 1·10764. This necessitates a recalculation of Longsworth's data. E. Swift (*J. Amer. Chem. Soc.*, **61**, 198; 1939) has made experiments on the densities of mixtures of heavy water and ordinary water at 5° and 25°, and finds that from the point of view of density these mixtures form ideal solutions at both temperatures. The constants used in Longsworth's equation were found to reproduce the results, the only change being that for the specific gravity of pure deuterium oxide. If $\triangle S$ is the density difference referred to pure protium oxide (taken as 15 p.p.m. lighter than tap water) then the mol fraction (N) of D_2O in a mixture at 25° is given by the equation $N = 9{\cdot}257\ \triangle S/(1 - 0{\cdot}033\ \triangle S)$.

Non-Stoicheiometric Oxides of Chromium

IN addition to the well-known oxides CrO_3 and Cr_2O_3, a large number of oxides of chromium have been reported, including a dioxide CrO_2. A Cameron, E. H. Harbard and A. King (*J. Chem. Soc.*, 55; 1939) have now shown that CrO_3 decomposes thermally in two stages with the formation of two non-stoicheiometric oxide ranges: (*a*) $CrO_{2\cdot6} - CrO_{2\cdot2}$

and (*b*) $CrO_{1.9}$–$CrO_{1.9}$. Many oxides previously reported lie in one or other of these ranges. The methods claimed to give the dioxide were examined and it was shown that (i) the product of low temperature decomposition of ammonium dichromate contains nitrogen; (ii) the oxide formed by heating CrO_3 in oxygen is in the non-stoicheiometric range (*a*); (iii) the oxide formed by the action of CrO_3 on chromic hydroxide lies in range (*b*). The recent work of Moles and González which claimed to have substantiated the individuality of chromium dioxide is thus, apparently, invalid.

Recording Sound by means of Films

SOUND-FILM recording is now a large and important industry. Even in the earliest days of cinematography attempts were made to develop sound-recording on metal and photographic films, but it was not until practical forms of thermionic amplifiers were developed that recording became of more than scientific interest. On February 20 Mr. D. W. Boston read to the London Students' Section of the Institution of Electrical Engineers a paper on the art of sound-film recording. To record sound on film the main requirements are a lightproof box provided with means for driving the film at constant speed and some means of producing a beam of light, so that it falls on the face of the film, and which can be modulated at audio-frequency. As the film runs past the beam of light it produces a trace which when developed appears as a band the width and darkness of which varies according to the method of light modulation employed. This trace is known as the 'sound-track' and depends on the shape of the oscillogram of the recorded sound wave. The lightproof box and associated apparatus is called a 'sound camera'. For reproduction the film speed must be the same as when recording. A beam of light similar to that used in recording, but unmodulated, falls on the sound track and the light passing through the film is modulated by the recorded wave form. The light now falls on photo-electric cells giving rise to audio-frequency currents which can be amplified and fed to loud-speakers. Sound tracks are of two types, variable density and variable area. The first of these types is produced by a light beam of constant width but variable density. A light beam modulated in this way is produced by a glow lamp with a suitable current passing through it. As a rule this method gives insufficient light, so now some form of mechanical light valve is used. If the sound-track of the reproducer is opaque, there is very little background noise, but if it is clear, noise will arise due to dirt, grain and scratches interrupting the light. Recent developments in sound recording are mainly due to methods of getting rid of this noise.

The Metadyne in Electric Traction

THE 'metadyne' is a new form of electric machine utilizing the principles on which both the dynamo and the motor work. The currents in some of the windings of the armature tend to produce rotation in one direction and the currents in others tend to produce rotation in the opposite direction, the object in view being to get rapid acceleration when starting and rapid retardation when stopping. The great advantage of the metadyne is that when going at speed it can be pulled up rapidly by utilizing some of its own kinetic energy of motion without drawing on electric power from the electric supply line as, for example, when a mechanical brake is applied. Used in traction when trains are frequently starting and stopping, this leads to a considerable economy in the cost of the power expended. The metadyne was invented a few years ago, and developed in a number of devices applicable in practice for various purposes by J. M. Pestarini, now of the University of Turin. In a paper read to the Institution of Electrical Engineers on February 23 by G. H. Fletcher and A. Tustin, its application to electric traction on suburban railways was specially considered. After preliminary experiments, the London Passenger Transport Board placed an order for fifty-eight metadyne equipments with Metro-Vickers, all of which are now in constant service. It was found that at 3 m.p.h. per second (average) the speed was too high to permit of full braking being obtained on the 'motored' axles as the limit of adhesion of the wheels was exceeded. It was found necessary to apply air-brakes to the 'non-motored' axles at the same time as 'regeneration' was applied to the motored axles. During normal braking, approximately two thirds of the total braking effort is applied through regeneration and one third by air brakes. The metadyne principle was first applied to the Diesel electric shunting engines on the Paris-Orléans line and was most successful.

Corrosion of Underground Cables

MODERN telephone systems utilize extensive networks of bare lead-sheathed cables drawn into earthenware conduits, and although lead is one of the least corrodible of metals, as witnessed by the fact that many lead roofs exist which are five centuries old, and that the Romans employed lead water pipes some of which are said to be in use to-day, yet the replacement of corroded telephone cables costs the Post Office £50,000 per annum. In a paper read to the Institution of Electrical Engineers on March 8 by W. G. Radley and C. E. Richards, of the Post Office Engineering Research Station, it is stated that laboratory examination of samples of corroded sheathing, together with chemical analysis of the corrosion products and soil waters enable definite conclusions to be reached as to whether there has been electrolytic stimulation by stray currents or not. Useful information has been obtained from apparatus recording the sheath current at two points a short distance apart and accurate determination of the small potential difference existing between a sheath and its immediate surroundings. Localities exist, chiefly in certain provincial cities, where corrosion due to tramway stray currents is very rapid. There are also areas in rural districts, chiefly in south-east England, where the soil water is so rapidly corrosive to lead that it is now the normal practice to install there cables with some form of protective covering. The non-metallic cable sheath which has been discussed for a number of years does not yet seem to be within the realms of early possibility. Advantages are to be gained from the liberal application of a suitable cable lubricant. Considerable increase in the life of Post Office cables subjected to chemical corrosion has resulted from the addition of a silicate inhibitor to the petroleum jelly used as a lubricant. The success that has been attained has in nearly every case been due to the formation of a local 'electrolysis committee' for considering all the underground services—gas, water, electric light, telephones, etc., within the area.

The Enzyme System of Trans-Amination, its Mode of Action and Biological Significance

By Prof. A. E. Braunstein, The A. M. Gorky All-Union Institute of Experimental Medicine, Moscow

THE reversible transfer of amino groups between aminodicarboxylic acids and α-ketoacids, or 'trans-amination', reported in a series of papers by me and my associates[1], is of almost universal occurrence in biological objects. It is readily effected by most animal tissues[2], and also, as shown in this laboratory[3] and independently by Virtanen[3] and Euler *et al.*[4], by vegetable tissues and micro-organisms. Trans-amination is effected by a special group of intracellular enzymes, for which the name *aminopherases* is suggested (in preference to the clumsy although more precise term aminotransportases). As trans-amination involves intermolecular oxido-reduction, the aminopherases should be classed among the desmolases. They differ in mode of action and in many properties from the formerly known enzymes of amino acid metabolism, including the *l*- and *d*-deaminases and specific glutamic and aspartic dehydrogenases.

The process of trans-amination can only take place with the participation of a dicarboxylic α-amino or α-ketoacid, functioning either as a stoichiometrical reaction partner (donator or acceptor of amino groups) or as a catalyst, or intermediate carrier of amino nitrogen, rendering possible the enzymatic shift of NH_2-groups from amino- to ketomonocarboxylic acids. In the latter case, that is, in the presence of low concentrations of the dicarboxylic carriers, trans-amination is competitively inhibited by saturated dicarboxylic acids (oxalic, malonic, glutaric, adipic acid)[5]. All experimental data point to the special role in trans-amination of the two acidic groups in the dicarboxylic acid molecule. However, it is the peculiar electrostatic configuration, or polarity, of such a molecule, rather than the particular behaviour due to the presence of two carboxyl groups, that determines the availability of the substrate molecule for trans-amination. This is evidenced by the fact that α-amino acids similar in electrostatic structure to aspartic or glutamic acid but bearing, instead of the second carboxyl group, some other acidic substituent group (for example, phosphoserine, cysteic acid[6] and homocysteic acid[5]), are adequate substrates for trans-amination, like the aminodicarboxylic acids. The formation of aminopherase-substrate symplexes evidently depends upon affinity of the enzyme to the two electronegative acidic groups of the substrate—most likely, due to the presence in the enzyme molecule of two electropositive basic groups forming a 'haptophoric' centre. Hence the inhibitory effect of simple dicarboxylic acids, displacing the amino- or ketodicarboxylic acids from the haptophoric centre. It follows that the substrates of trans-amination belong to two different types, namely:

(*a*) 'Primary' or 'active' substrates—those exhibiting direct affinity to the enzyme and capable of reacting with mono- or dicarboxylic partners alike. This type includes the natural amino- and ketodicarboxylic acids (and some related acids, like mesoxalic, oxyoxosuccinic and α-ketoadipic acid[5]), as well as other dibasic acids such as phosphoserine, cysteic and homocysteic acid.

(*b*) 'Secondary' or 'passive' substrates—all monocarboxylic α-amino and α-ketoacids lacking direct affinity to the aminopherases and trans-aminated only as partners of the primary dicarboxylic substrates or with their intermediation in the case of catalysed trans-amination. The availability of secondary substrates depends upon the presence of a keto or free amino group in the α-position to a free carboxyl. β- or γ-amino or ketoacids, simple amines, aldehydes, ketones or hydroxyketones are inadequate; di- and tripeptides are not trans-aminated unless hydrolysed by contaminating peptidases.

There exist several aminopherases differing in specificity with respect to primary substrates. Two such individual enzymes have been obtained in cell-free solution, and purified to some extent, in this laboratory by Mrs. M. Kritzmann[7]. One of these enzymes catalyses the shift of amino nitrogen from glutamic or to ketoglutaric acid; the other—more readily extractable from tissues and more labile—effects trans-aminations involving aspartic, resp. oxaloacetic acid. We propose the names *glutamic aminopherase* and *aspartic aminopherase* for the respective enzymes. (Preliminary experimental data indicate that our enzyme preparations react with some further primary substrates besides their natural ones: thus, glutamic aminopherase transfers amino nitrogen to mesoxalic and α-ketoadipic acid, whereas the specificity of the aspartic enzyme extends only to oxyoxosuccinic acid; phosphoserine, cysteic and homocysteic acid, while adequate as primary substrates in experiments with muscle pulp, are only secondary substrates for purified preparations of both aminopherases[6]). The aminopherases are optically selective: only the natural *l*-forms of the amino acids act as NH_2-donators with aminopherase solutions, and the amino acids formed as reaction products also belong to the *l*-series (in whole muscle pulp a slight transformation of *d*-amino acids has been observed in some cases, but evidence on this point is not conclusive)[5].

The presence of aminopherases in most types of living cells suggests that they play an important part in nitrogenous metabolism, especially in the many tissues devoid of the enzymes required for direct formation and breakdown of aminomonocarboxylic acids (for example, muscle, brain, plant tissues). Several enzyme systems of wide distribution in various living tissues are known at the present, specifically and reversibly catalysing the synthesis and deamination of aminodicarboxylic acids (aspartases I and II, Virtanen's oxaloacetic oxime system[3], glutamic and aspartic dehydrogenases). In association with such enzyme systems the aminopherases provide an adequate mechanism for the synthesis and

deamination of all amino acids in tissues containing no universal amino-oxhydrases. Ever since the first publications on trans-amination, I have pointed out the possible role of trans-amination in the synthesis of aminoacids in vegetable organisms, where the aminodicarboxylic acids apparently belong to the first organic products of nitrogen assimilation[3]. Recently, Virtanen[2] and Euler, Adler *et al.*[4] have reported experimental evidence supporting, though not conclusively proving, the role of the trans-amination mechanism in amino acid synthesis.

We wish to point out that the properties of *l*-deaminase (Krebs, Bernheim) indicate the complex nature of this enzyme and suggest that oxidative deamination of the *l*-amino acids is also probably due to the co-operation of aminopherases, glutamic or aspartic dehydrogenase and catalytic amounts of the respective dicarboxylic acids. Experimental verification of this hypothesis is in progress. If such be the case, it would follow that the dicarboxylic amino- and α-ketoacids function as intermediate carriers not only in the interconversion of amino acids by trans-amination, but also in their synthesis from ammonia and deamination, thus forming a transition channel between mineral and organic nitrogen.

Summary.—The results of recent investigations concerning the transfer of amino-groups between amino- and ketoacids are discussed. These investigations led to the discovery of a new group of intracellular enzymes, termed aminopherases. A survey is given of the range of specificity and mode of action of these enzymes. The biological significance of the aminopherases and of the dicarboxylic amino- and ketoacids is discussed with a view to their probable role as key substances in the biological formation and breakdown of amino acids.

[1] Braunstein, A. E., Kritzmann, M. G., *Enzymologia*, **2**, 129 (1937). *Biochimia* (Moscow), **2**, 242, 860 (1937); **3**, 590, 693 (1938); **4**, No. 2 (1939).
[2] Kritzmann, M., *Enzymologia*, **5**, 44 (1938). *Biochimia*, **3**, 28 (1938).
[3] Virtanen and Laine, NATURE, **141**, 748 (1938).
[4] Euler, H., Adler, E., *et al.*, *Z. physiol. Chem.*, **254**, 61; 255, 14, 27.
[5] Braunstein, A. E., (unpublished data).
[6] Bychkov, S. M., *Biochimia* (1939, in the Press).
[7] Kritzmann, M. G., *C.R. (Doklady) Acad. Sci. U.R.S.S.*, **21**, 42 (1938). NATURE (this issue, p. 603).
[8] *Biochimia*, **2**, 257 (1937).

The Atmosphere as a Raw Material*

IN the middle of the seventeenth century, the phlogiston theory was generally accepted. Scientific study of the atmosphere only began in the last quarter of that century, and within fifty years of Stahl's formulation of the theory, it had been displaced, and oxygen had been recognized, isolated and identified. In little more than a century, the composition of air was known to 1 per cent, and not very long afterwards, Ramsay completed the story with his discovery of the inert constituents. At the present time, gases which are only present to the extent of one drop in 130 gallons are articles of everyday commerce.

Although use is now being made of the atmosphere as a raw material of industry, our demands are as yet quite unlikely to affect the stock appreciably. England and Scotland have twenty or more factories taking the oxygen from 20 million cubic feet daily, but this large amount ceases to seem dangerous when we remember that the population of those countries uses 600 million cubic feet daily in the ordinary course of respiration; animals add their demands to this figure, and the total is again vastly increased by the supply required for the daily combustion of wood, coal and petrol. The case is in marked contrast to that of coal. Mankind is continuously oxidizing carbon, and yet rapidly diminishing the amount of the only agent—vegetation—that can renew his exhalations to a useful atmosphere. The energy from sunlight received in a growing season by an acre of land is equivalent to that obtained by the combustion of 243 tons of anthracite. If 25 bushels of corn are reaped from the acre, they return energy equivalent to only 0·3 tons of anthracite. Nor is the prospect from water power very favourable. It is estimated that the hydro-electric power available from the whole rainfall of America is about equal to the present power production from coal.

So far as the production of carbon dioxide by human beings is concerned, it is interesting to calculate that a man exhales about 3 lb. per day; a eucalyptus tree of the mountain ash type, 200 feet high and weighing 24 tons, is capable of breaking down about one third of this amount and returning the oxygen to the atmosphere. It is clear therefore that the tendency to replace vegetation of this type by buildings, or even by cereal crops, carries with it a potential danger to the oxygen supply.

It was about the year 1885 that man began to abstract oxygen from the air for its own sake, when the barium oxide process was first used commercially. At first, much of the oxygen was used for therapy, and for the limelight. Now that this is replaced by electric light, about 98 per cent of the oxygen prepared is used in engineering, either for metallurgical, fabricating, or cutting purposes. Of course, the oxygen is no longer extracted by chemical processes, but by liquefaction and subsequent rectification, in plants that can make 4,000 gallons an hour for days on end. The fractional distillation of liquid air depends for its success on the heat exchange tray devised by Kuhni, and known as a 'foam plate'. In it, a disk is built up in a true spiral, with about 10,000 holes to the square inch.

Turning now to the inert gases, argon is present to the extent of about 1 per cent, but was only detected in 1894 by Ramsay and Rayleigh. It is now separated directly in a state of comparative purity from commercial oxygen distilling apparatus. At the present time, about 10 million cubic feet are used annually to fill the 1,000 million electric lamps produced in the same time. Neon exists only to the extent of 1 part in 55,000, but its characteristic spectrum has led to the use of thousands of litres annually in 'neon lights' so widely used in advertising signs.

*Substance of the presidential address delivered to Section B (Chemistry) of the Australian and New Zealand Association for the Advancement of Science, by Russell Grimwade, C.B.E., on January 12, 1939.

Helium, present to the extent of one part in 245,000, or 50 tons in the atmosphere above each square mile of the earth's surface, is the lightest uninflammable gas, and is thus of especial use in lighter-than-air craft. For this purpose it is collected from the gases of certain bore-holes in the United States, where it is present to the extent of 1–2 per cent. It is of particular value medically in that an artificial atmosphere of helium and oxygen can prevent Caisson disease or 'the bends', a malady, due to the solubility of nitrogen in human blood serum, to which divers and others working under increased pressure are subject. Krypton, occurring only to the extent of 1 part in a million, and xenon, only one tenth as abundant, are not used very extensively as yet, but the fact that they increase the efficiency of an electric lamp filament by 10 and 20 per cent respectively, suggests that they will eventually be in common use.

The remaining constituent of the atmosphere, nitrogen, constitutes 81 per cent of its volume. From about 1830, nitrogen was chiefly obtained from the *caliche* deposits in Chile, and the rate of extraction was so fast that in 1898 Crookes predicted a world famine in nitrogen, and therefore in agricultural products, at no very distant date. Within a very few years, the situation was changed by the establishment of the first plant for the production of nitric acid from atmospheric nitrogen. That first process, depending on the electric arc, has now been superseded, first by the cyanamide process, and then by the Haber process, in which the immediate product is ammonia, instead of oxides of nitrogen. It is of interest to note that the arc process, with the production of oxides, is the one used by Nature herself as the main agency for restoring nitrogen to the earth's surface for agricultural needs; her arc is the lightning flash. In 1937 there were 145 plants operating on the Haber process, producing nearly 4 million tons of fixed nitrogen, an amount which, though large in itself, is only the amount to be found above 1/5 square mile of the earth's surface. In any event, the nitrogen withdrawn from the air almost all ultimately finds its way back again, through the agency of living matter.

From the consideration of these matters, we are eventually reminded that the balance of Nature is the only basis of man's existence. It will demand control over vegetation which has been lacking ever since the inception of the industrial period, and it is to chemists that the world should look for a lead.

Factor Analysis in Psychology

AT the general meeting of the British Psychological Society, held this year at the University of Reading, a symposium on factor analysis attracted on April 1 the largest number of members present for several years at any meeting of the Society.

Opening the symposium, Prof. Godfrey Thomson said that many sets of factors are mathematically available, and principles have to be adopted for deciding between them. These have included: (1) the universal desire to use few common factors; (2) reproducing the whole variance; (3) reproducing the correlations; (4) insistence on a general factor; (5) rotating to psychological significance; (6) requiring 'simple structure'; (7) requiring invariance of analysis; (8) requiring reciprocity of persons and tests. The second loses least information, but conflicts with (5) and (7). The third principle is used by both the Spearman and Thurstone schools; the former proceeds step by step, the latter by a simultaneous analysis. The Spearman school safeguards psychological significance at each step, and insists on a general factor. The Thurstone plan rotates the factors into 'simple structure' and holds that psychological significance will ensue. 'Simple structure' seems to rule out a general factor, and Thurstone finds no g in Spearman's own g-tests. Both methods result in large specific factors, and have more factors than tests, so that the factors cannot be accurately estimated. The last principle (8) is put forward by Burt, who analyses covariances. His reciprocity is only obtained, however, after removal of a factor composed of the average.

Prof. Spearman's paper, read by Mr. Maxwell Garnett, directed attention to the disappearance of the general factor in Thurstone's "Primary Mental Abilities". A set of correlations, he said, can be factorized in many ways, the choice being regulated by statistical simplicity and psychological interest. The theory of two factors uses a method which draws all the correlations from one factor. Statistically simple, it affords psychologically the basis for the concepts of general ability. Hotelling, Kelley and Burt, in securing that the weights of factors are heaped up in order of calculation, generate negative loadings which contradict experience. Alexander and Thurstone, in rejecting negative loadings, decrease without eliminating the indeterminateness. Thurstone in addition maximizes the number of zeros. It is this which banishes the general factor, for weights which fall below a certain minimum are ascribed to error and counted as zero. Moreover the number of Thurstone's factors creates suspicion.

Correlations alone fail to determine factors completely: other grounds are needed. In the special case of one single factor we have the cogent ground of parsimony; in all other cases to find adequate grounds is difficult.

Prof. Burt emphasized that the components obtained by factorizing a correlation table describe an analysis of the relations between minds and their environments. Whether a factor has meaning depends on the appropriateness of the experimental design as much as on the validity of the analysis. Factor analysis should, if possible, be based on covariances rather than on correlations. Variance varies objectively, and depends primarily on the complexity of the process measured. When the errors are sufficiently small, all analyses reveal a series of factors whose contributory variances are roughly 50, 12, 5 . . . per cent of the total. This may be explained by regarding factor analysis as a process of successive averaging. Concerning the 'sampling theory', he said that an effective test *integrates* a wide *variety* rather than samples a large number of co-ordinations.

Accepting Prof. Thomson's equation, it can be shown that the sum of the test-measurements operates as the general factor in his hierarchies. If we assume that intelligence depends on the number and systematic arrangement of the unorganized synapses of cortical neurones, this interpretation appears equally plausible from a physiological point of view. He reiterated his belief in the reciprocity principle and his opinion that the bipolar factors obtained by correlating tests and persons respectively are essentially identical.

Dr. W. Stephenson said that Prof. Thomson would appear to take tests for granted and to seek to identify the qualities of persons tested with selected factor axes. It seemed to him that tests should have something to say about the axes to be selected, and that we should define axes at the *outset* on psychological grounds. Mathematical theorems would then be used to see whether these axes are consistent with facts.

There is a great deal of equivocality in the use of the word 'ability' in factor analysis, and he proposed a definition which relates abilities to what he called *non-fractional* factors for cognitive activity, a *non-fractional* factor being a kind of compound of the 'fractional' factors usually discussed.

A general discussion followed the papers. In summing up, Prof. Godfrey Thomson said that as Thurstone was not present he thought he ought to say something on behalf of the idea of 'simple structure'. Recently he had heard Prof. P. A. M. Dirac support the thesis that when he found a hypothesis or solution of great mathematical beauty he could have considerable confidence that it would correspond to something real in physical Nature. Something of the same sort, Prof. Thomson imagined, was behind Thurstone's faith in 'simple structure'.

On the other hand he felt that Prof. Spearman would have been justified in putting up a more fundamental defence of g than he had. For the blemishes criticized in Thurstone's work could be removed by care, and Thurstone might still attain 'simple structure' in chosen batteries. The real defence of g was surely that it had proved to be useful.

University Events

ABERDEEN.—On March 29, the honorary degree of LL.D. was conferred on the following among others: Prof. J. Gray, professor of zoology in the University of Cambridge; Dr. J. McIntosh, director of the Bland-Sutton Institute of Pathology, Middlesex Hospital.

The ordinary degree of D.Sc. was conferred on Dr. J. S. McPetrie for a thesis entitled "Studies in the Production and Propagation of Radio Waves".

CAMBRIDGE.—Dr. O. M. Solandt, of Trinity Hall, has been appointed University lecturer in mammalian physiology.

N. B. Slater, of Gonville and Caius College, has been appointed second junior observer at the Solar Physics Observatory.

Sir Edward Mellanby, of Emmanuel College, secretary of the Medical Research Council, will deliver the Rede Lecture at 5 p.m. on April 28, the subject of which will be "Some Social and Economic Implications of the Recent Advances in Medical Science".

Science News a Century Ago

The Royal Society

AT a meeting of the Royal Society on April 11, 1839, James Finlay Weir-Johnston (1796–1855), the agricultural chemist, read a paper "On a New Equiatomic Compound of Bicyanide with Binoxide of Mercury". In the paper he gave an account of the properties of "a salt, obtained by agitating, with red oxide of mercury, a small portion of hydrocyanic acid, and which he found to be distinguished from the bicyanide of mercury by its sparing solubility in cold water, by the alkaline reaction exhibited by its solution (a property which indicates an excess of mercury) and by its susceptibility of detonation by heat, depending on this excess being in the state of an oxide and on the carbon of the cyanogen it contains, and the presence of which is shown by the disengagement of hydrochloric acid gas when acted on by hydrosulphuric and hydrochloric acid".

At the same meeting Felix Savart (1791–1841), the successor of Ampère at the Collége de France, Macedoine Melloni (1798–1854) the Italian physicist, and Lambert Adolphe Jacques Quételet (1796–1874), the Belgian astronomer and statistician, were elected foreign members.

Lacaille's Astronomical Observations at the Cape

ON April 12, 1839, the concluding part of Thomas Maclear's paper "On the Position of Lacaille's Stations at the Cape of Good Hope" was read. The lapse of 85 years since Lacaille's visit had obliterated all local evidence of the French astronomer's operations, and the fact that he had been there at all was only kept alive by the inquiries of Captain Everest in 1821. Having by inquiries found the house Lacaille resided in, Maclear measured the position of the house relative to the Royal Observatory by triangulation. He then proceeded to discover the exact site of Lacaille's northern station at Klyp-Fonteyn. With the assistance of a party from the Royal Engineers he made excavations of various ruins and so unearthed the foundation of the granary used by Lacaille.

Geology in Russia

"SOME idea of the activity of the Russians in pursuit of science, but especially that of geology," said the *Athenæum* of April 12, 1839, may be gathered from the following statements. "The Inspector in Chief of Mines, the Count Cancrina, has for several years obtained his Imperial Majesty's permission to make geological and mineralogical researches in various parts of the vast empire, and a scientific committee has been established to superintend the publication of a work entitled 'Annals of the Russian Mines'. M. Parrot, Professor at the University of Dorpat, was ordered by the Russian government to explore Armenia and Transcaucasia. . . . M. Kupffer has determined the height of the Elbrous, the culminating point of the Caucasian chain, and is at this moment making meteorological and magnetic observations throughout the Empire. Baron de Humboldt and M. Rose have traversed the northern mountains, M. de Pasch has described the chalk formations in the south of Poland, M. Pander those of the neighbourhood of St. Petersburgh . . . M. de Semenoff, principal engineer of mines, has described the geological formation of the northern part of the Altai Mountains."

Societies and Academies

London

Royal Society (*Proc.*, A, **170**, 1–144; 1939).

I. LANGMUIR: Molecular layers. (Pilgrim Trust Lecture).

T. SVEDBERG and others: The protein molecule (Discussion).

W. E. GARNER and A. J. HAM: Combustion of methane.

E. E. SCHNEIDER, C. F. GOODEVE and R. J. LYTHGOE: Spectral variation of the photosensitivity of visual purple.

W. G. PENNEY and G. J. KYNCH: Magnetic susceptibility and related properties of rare-earth crystals.

J. J. BIKERMAN: Formation and structure of multilayers.

Paris

Academy of Sciences (*C.R.*, **208**, 685–776, March 6, 1939).

E. ESCLANGON: Dynamometric forces and field forces.

H. VINCENT: Pathogenic characteristics of the micro-organisms of gas gangrene; fundamental principles of anti-gangrene serotherapy.

C. BENEDICKS: Remarks on the generation of parallelopipeds of n dimensions.

S. BERGMANN: Approximation of functions satisfying a linear equation with partial derivatives.

F. ROGER: A classification of extremals.

E. HALPHEN: Convergence of estimations.

G. PÓLYA: Integral interrupted series which are not extensible.

G. VALIRON: Riemann surfaces defined by certain integral functions.

M. ZORN: Abstract theory of analytical functions.

H. CARTAN: Solution of Carleman's problem for a closed finite integral.

J. DUFRESNOY: Meromorph functions in an angle.

A. OUDART: Problem of wakes; validity of solutions.

J. K. DE FÉRIET: Spectrum of homogeneous turbulence.

M. LUNTZ: Isotropy of turbulent movements and the distribution of energy between translation and rotation.

L. SACKMANN: Singularities in the study of a model wing.

H. FABRE: Gaps in the asteroid ring considered as resonance phenomena.

H. MÉMERY: An anomaly of the solar period 1923–33. This period showed 5–6 years of increasing activity followed by 4–5 years of decreasing activity; generally the period of decrease is greater. The same phenomena occurred in 1723–33 and 1823–33, confirming the author's previous suggestion of a 100-year cycle of 9 periods of 11·1 years.

J. LAGRULA: New measurements of the intensity of gravity in the Departments of Algiers and Constantine.

F. CARBENAY: High-frequency telephony along triphase power transport lines.

G. FOËX: Constant paramagnetism of tetravalent cerium and of other ions having the same number of electrons as the rare gases.

P. LAMBERT and J. LECOMTE: Absorption of acrolein in the infra-red spectrum.

C. MAGNAN: Disruption of the nuclei of elements lighter than uranium, under neutron bombardment. Positive effects were obtained with gold, tungsten and titanium.

J. THIBAUD and A. MOUSSA: Disruption of uranium nuclei under the action of neutrons, and the liberation of energy which results. Chemical separations suggest that an isotope of bromine is formed.

A. BOUTARIC and MLLE. S. THÉVENET: Viscosity of arsenic sulphide sols and Einstein's formula.

W. S. REICH: Separation of oses by chromatography of their coloured esters.

E. DARMOIS, Y. DOUCET and MLLE. M. MURGIER: Cryoscopy of molybdic acid in aqueous solution.

G. DÉJARDIN: Red bands of cyanogen in the spectrum of the night sky.

R. GRANDMONTAGNE: Remarks on the variation of colour of the night sky. During 1938, radiation at the beginning of the red, 5850–6800 A., was particularly weak from March to August.

S. MAZLOUM: Analysis of the components of the Euphrates in Syria.

J. BOURCART: Origin of the silts of the maritime Seine.

B. RAJČEVIĆ: Salinity of the waters of the Seine between Amfreville and Honfleur.

C. FRANCIS-BŒUF: Variations of salinity, during a day in September, of the waters of the maritime Aulne at Trégarvan.

R. LAMI: Conditions of illumination of some algæ living in the grottoes and littoral defiles of the Falkland Islands.

L. GALLIEN: Hypophysectomy and the sexual cycle of *Rana temporaria* L.

P. MEUNIER and C. BLANCPAIN: Quantitative determination of the antineuritic vitamin in natural media; new technique.

P. BOQUET: The role of copper in the attenuation of viper venom (*Vipera aspis*) by hydrogen peroxide.

MLLE. R. SCHOEN: Transmission of the Nicolas and Favre malady by nasal instillation in the white mouse.

A. STAUB: Vaccination against swine fever.

Dublin

Royal Dublin Society, February 21.

A. G. G. LEONARD and BRIDGET MCVERRY: Atmospheric pollution in Dublin during the year 1938. Measurements of atmospheric pollution including suspended impurity and estimations of sulphur dioxide have been carried out continuously near the centre of Dublin for the year 1938, and are compared with records published for English cities for 1937.

O. ROBERTS and S. A. STYLES: An apparent connexion between the presence of colloids and the osmotic pressures in conifer leaves. There is good agreement between the osmotic pressures of conifer leaves as determined by the plasmolytic and cryoscopic methods when the leaves in question are colloid-free. In conifer leaves which contain mucilaginous colloids and have slimy or viscous saps, there is a wide disparity between the results by the two methods. The cryoscopic results agree with the others in the literature, but the plasmolytic osmotic pressures are always very much higher.

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

HEAD OF THE ENGINEERING DEPARTMENT, Luton Technical College—The Principal (April 15).

PRINCIPAL of the Bengal Engineering College, Sibpur, Calcutta—The High Commissioner for India, India House, Aldwych, London, W.C.2 (April 17).

LECTURER IN PHYSICS in the Battersea Polytechnic, London, S.W.11—The Principal (April 21).

JUNIOR SCIENTIFIC OFFICERS in the Electricity, Metrology, Engineering and Aerodynamics Departments of the National Physical Laboratory, Teddington, Middlesex—The Director (April 24).

LECTURER IN THE HYGIENE AND PUBLIC HEALTH DEPARTMENT of the Battersea Polytechnic, London, S.W.11—The Principal (April 29).

PRINCIPAL of the Beaufoy Institute, S.E.11—The Education Officer (T.1), County Hall, S.E.1 (May 1).

ASSISTANT DEMONSTRATOR IN PHYSICS (Woman) in the Royal Holloway College, Englefield Green, Surrey—The Principal (May 1).

JUNIOR RESEARCH PHYSICIST for the National Research Council of Canada, Ottawa—The Secretary-Treasurer (May 15).

UNIVERSITY READER IN MECHANICAL ENGINEERING in the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, W.C.1 (May 17).

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Reports of the Progress of Applied Chemistry. Issued by the Society of Chemical Industry. Vol. 23, 1938. Pp. 861. (London: Society of Chemical Industry.) 7*s.* 6*d.*; to non-Members, 12*s.* 6*d.* [103

Air Ministry: Aeronautical Research Committee: Reports and Memoranda. No. 1835 (3054): Airscrew Blade Vibration. By J. Morris. Pp. 30. 4*s.* net. No. 1836 (3583): Elevator-fuselage Flutter. By G. A. Naylor. Pp. 8. 1*s.* 3*d.* net. No. 1838 (3140 and 3268): The Calculation of the Profile Drag of Aerofoils. By H. B. Squire and A. D. Young. Pp. 27. 4*s.* net. No. 1841 (3602): Hydraulic Operator for Remote Balance Control. By Dr. A. S. Halliday and C. H. Burge. Pp. 4+1 plate. 1*s.* net. (London: H.M. Stationery Office.) [103

Imperial College of Science and Technology: Department of Chemical Technology. Report, 1937–1938. Pp. 24+4 plates. (London: Imperial College of Science.) [113

Ministry of Health. Report of the Committee of Inquiry into the Anti-Tuberculosis Service in Wales and Monmouthshire. Pp. 291. (London: H.M. Stationery Office.) 4*s.* 6*d.* net. [113

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 784, Vol. 237: Electromagnetic Induction in Non-uniform Conductors, and the Determination of the Conductivity of the Earth from Terrestrial Magnetic Variations. By B. N. Lahiri and A. T. Price. Pp. 509–540. 4*s.* No. 785, Vol. 237: The Accurate Analysis of Gaseous Mixtures. By B. Lambert and D. J. Borgars. Pp. 541–566. 3*s.* 6*d.* No. 786, Vol. 238: The Refraction and Dispersion of Air for the Visible Spectrum. By H. Barrell and J. E. Sears, Jr. Pp. 1–64. 8*s.* No. 787, Vol. 238: An Absolute Determination of the Acceleration due to Gravity. By J. S. Clark. Pp. 65–124. 7*s.* (London: Cambridge University Press.) [133

Department of Scientific and Industrial Research. Methods for the Detection of Toxic Gases in Industry. Leaflet No. 5: Nitrous Fumes. Pp. iv+9. (London: H.M. Stationery Office.) 3*d.* net. [133

Bacon Development Board. Bulletin No. 4: Selected Abstracts on Pig Production, 1938. Pp. 59. (London: Bacon Development Board.) 2*s.* 6*d.* [153

Ministry of Health. Report on the Work of the Central Midwives Board for the Year ended 31st March 1938. Pp. 20. (London: H.M. Stationery Office.) 4*d.* net. [153

Hull Museum Publications. No. 199: Early Lighting Appliances. By T. Sheppard. Pp. 16. No. 200: Catalogue of the Railway Museum (Paragon Station, Hull.) By T. Sheppard. Pp. 32. 2*d.* No. 201: Hull Museums and Advertising. By T. Sheppard. Pp. 12. (Hull: Hull Museum.) [173

Bacon Development Board. Bulletin No. 2: Substitutes for Cereals in Pig-Keeping. Revised edition. Pp. 70. (London: Bacon Development Board.) 2*s.* 6*d.* [173

Department of Scientific and Industrial Research: Forest Products Research. Bulletin No. 14: Moisture Content Determination. By R. A. G. Knight. Second edition. Pp. iv+22+2 plates. (London: H.M. Stationery Office.) 9*d.* net. [203

Other Countries

Fouad I University. Bulletin of the Faculty of Science, No. 18: Binding of Water in relation to Drought Resistance, by Dr. Ahmed Mohamed Migahid; Two New Cyanophyceæ from the Red Sea, by Prof. B. Frémy and A. H. Nasr. Pp. 34+2 plates. (Cairo: Fouad I University.) [93

Estudos sobre dielectricos. Pelos B. Gross e P. S. Rocha. Pp. 61+2 plates. (Rio de Janeiro: Instituto Nacional de Tecnologia.) [93

Geographical Index to the Memoirs, Vols. 1–54, Records 1–65, of the Geological Survey of India and General Reports of the Director for the Years 1897 to 1903. By T. H. D. La Touche. Pp. xvi+576. (Calcutta: Geological Survey of India.) 6.12 rupees; 11*s.* [93

Zoological Series of the Field Museum of Natural History. Vol. 24, No. 1: New Central American Frogs of the Genus Hypopachus. By Karl P. Schmidt. Pp. 6. 10 cents. Vol. 24, No. 2: A New Lizard from Mexico, with a note on the Genus Norops. By Karl P. Schmidt. Pp. 7–10. 10 cents. Vol. 24, No. 3: A New Australian Lizard, with a Note on Meniergis. By Hobart M. Smith. Pp. 11–14. 10 cents. Vol. 24, No. 4: Notes on Mexican Reptiles and Amphibians. By Hobart M. Smith. Pp. 15–36. 25 cents. (Chicago: Field Museum of Natural History.) [103

State of Connecticut: State Geological and Natural History Survey. Bulletin No. 60: Additions to the Check-List of the Insects of Connecticut (First Supplement to Bulletin No. 31), by Dr. Wilton Everett Britton; and Check-List of the Spiders of Connecticut, by Dr. Benjamin Julian Kaston. Pp. 202. (Hartford, Conn.: State Geological and Natural History Survey.) 1 dollar. [103

Carnegie Institution of Washington. Year Book No. 37, July 1, 1937–June 30, 1938, with Administrative Reports through December 9, 1938. Pp. xxxiv+443. (Washington, D.C.: Carnegie Institution.) [103

Biosophical Institute. Biosophical Series, No. 4: The Synthesis of Science and Religion. By Frederick Kettner. Pp. 22. (New York: Biosophical Institute.) 10 cents. [103

Bulletin of the National Research Council. No. 102: Industrial Research Laboratories of the United States, including Consulting Research Laboratories. Sixth edition. Compiled by Callie Hull. Pp. 270. (Washington, D.C.: National Research Council.) Paper, 2.50 dollars; cloth, 3 dollars. [113

Advisory Committee on Education. Staff Study No. 5: Principles and Methods of Distributing Federal Aid for Education. By Paul R. Mort, Eugene S. Lawler, and associates. Pp. ix+98. (Washington, D.C.: Government Printing Office.) 20 cents. [113

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 22: Report on a Village Enquiry regarding Cattle and the Production and Consumption of Milk in seven Breeding Tracts of India. Pp. x+127. 3.8 rupees; 5*s.* 6*d.* Miscellaneous Bulletin No. 24: A Brief Survey of some of the Important Breeds of Cattle in India, Part 2: Prize Winners at the First All-India Cattle Show. Pp. ii+4+38 plates. 1.6 rupees; 2*s.* Miscellaneous Bulletin No. 27: Definition of Characteristics of Seven Breeds of Cattle of All-India Importance. Pp. iii+26+31 plates. 1.10 rupees; 2*s.* 6*d.* (Delhi: Manager of Publications.) [133

Geological Survey of Uganda. Bulletin No. 3: A Series of Papers relating to the Geology of Uganda, with Bibliography and Provisional Geological Map. Pp. vii+196+8 plates. (Entebbe: Government Printer.) 10*s.* 6*d.* [133

Mysore Geological Department. Popular Studies, No. 1: An Introduction to the Geology of Mysore. By R. Rama Rao. Pp. xiii+68+34 plates. (Bangalore: Government Press.) 1 rupee. [133

Journal of the Indian Institute of Science. Vol. 22A, Part 3: Supersonic Velocity in Gases and Vapours. Part 6: Specific Heats of the Vapours of Alcohols and Ethyl Acetate. By S. K. Kulkarni Jatkar. Pp. 39–58. (Bangalore: Indian Institute of Science.) 1.8 rupees. [133

Indian Forest Records (New Series). Botany, Vol. 1, No. 4: A Sketch of the Vegetation of the Aka Hills, Assam; a Synecological Study. By Dr. N. L. Bor. Pp. ix+103–222+22 plates. (Delhi: Manager of Publications.) 6.6 rupees; 10*s.* [133

Conseil Permanent International pour l'Exploration de la Mer. Bulletin hydrographique pour l'année 1937. Pp. xiv+106. (Copenhague: Andr. Fred. Høst et fils.) 7.00 kr. [133

Thalès: recueil annuel des travaux de l'Institut d'Histoire des sciences et des techniques de l'Université de Paris. Année 3, 1936. Pp. 266. (Paris: Félix Alcan.) 50 francs. [163

U.S. Department of Agriculture. Technical Bulletin No. 653: A Revision of the Mites of the Subfamily Tarsoneminae of North America, the West Indies, and the Hawaiian Islands. By H. E. Ewing. Pp. 64. (Washington, D.C.: Government Printing Office.) 15 cents. [173

League of Nations: Economic Intelligence Service. Statistical Testing of Business-Cycle Theories. 1: A Method and its Application to Investment Activity. By J. Tinbergen. Pp. 164. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 3*s.* 6*d.* [173

Report of the Haffkine Institute for the Year 1937. By Lt.-Col. S. S. Sokhey. Pp. iii+88. (Bombay: Government Printing and Stationery Office.) 3 annas; 4*d.* [173

India Meteorological Department. Scientific Notes, Vol. 7, No. 79: Atmospheric Electric Potential Gradient, Conductivity and Air-Earth Current on Electrically 'Quiet' Days at Colaba. By S. M. Mukherjee. Pp. 133–148+6 plates. (Delhi: Manager of Publications.) 1.4 rupees; 2*s.* [173

Plant and Animal Communities. Comprising the Proceedings of the Conference on Plant and Animal Communities, held at the Biological Laboratory, Cold Spring Harbor, Long Island, New York, from August 29 to September 2, 1938. Edited by Theodore Just. Pp. 255. (Notre Dame, Ind.: University of Notre Dame.) [173

Catalogues, etc.

Matthey Cadmium Pigments. Pp. 12. (London: Johnson, Matthey and Co., Ltd.)

Cambridge Instruments for Food Storage and Transport. (Folder No. 66.) Pp. 6. (London: Cambridge Instrument Co., Ltd.)

Wild-Barfield Electric Furnaces for Works and Laboratories. Pp. 52. (London: Wild-Barfield Electric Furnaces, Ltd.)

Die Askania-Warte. Jahrgang 4, Nr. 16, März-April. Pp. 25–48. (Berlin-Friedenau: Askania-Werke A.G.)

History of Science and a few rare and important Old Medical Books. (Catalogue 51.) Pp. 76+8 plates. (London: E. P. Goldschmidt and Co., Ltd.)